Science B44
FINAL EXAM 2004

The exam has a total of 150 points so a 4 point question should take about 5 minutes to answer and a 1 point question, a little more than a minute at most. The questions must be answered in 6 separate blue books, one for each of the 6 sections.

FIRST BOOK

Put your name and student ID on a new blue book, number the book #1 and begin. You should take no more than 30 minutes to finish the multiple choice and short answer questions for this section

BOOK 1 MULTIPLE CHOICE QUESTIONS.

Choose the one best answer for each and write the question number and the answer letter in your blue book, one answer per line. For example

1. c
2. b
3. b
and so on

1. Pinhole optical systems:
   a) Form good images in situations with lots of light.
   b) Form poor images even in the best of light.
   c) Focus only for specific distances.
   d) Are not actually used in any animal’s eyes.

2. Which of the following cell types is the origin of positive afterimages?
   a) Retinal ganglion cells
   b) Bipolar cells
   c) Cones
   d) Rods

3. How does the brain know whether items in the world have moved during large eye movements (saccades)?
   a) Find and subtract common minimal motion
   b) Compute how muscle commands would make image on retina move and subtract that.
   c) Suppress vision during the eye movements
   d) Maintain representation of object location before saccade and compare to object position after saccade.
4. Here again are the absorption spectra of the four receptors in the human eye. Labeling them from left to right, choose the appropriate order from the list below
   a) Rod, cone, bipolar, ganglion
   b) Yellow, blue, green, red
   c) **Blue, rod, green, red**
   d) Blue, green, super woman, red
   e) Red, green, rod, blue

5. Which of the following is **NOT** required for informed consent:
   a) The methods, risks and goals of the experiment must be explained to the subject.
   b) The subject must be given sufficient information to make an informed decision to participate.
   c) The experimenter must obtain written or verbal consent of the participant.
   d) **The subject must agree to complete the experiment once it has started.**

6. If an electrode is moved across the cortex in area V1, parallel to the surface, how will the orientation preferences of cells along the path vary?
   a) Orientation preferences will be constant
   b) Orientation preferences will vary randomly
   c) **Orientation preferences will vary systematically**
   d) No V1 cells are orientation selective

7. Which one of the following cell types in the visual system is orientation selective?
   a) retinal ganglion cells
   b) bipolar cells
   c) lateral geniculate cells
   d) **end stopped cells**
8. Which of the following is NOT true: Complex cells
   a) Are found in visual cortex.
   b) **Have receptive fields best mapped with spots of light.**
   c) Respond to light or dark bars.
   d) Are orientation selective

9. Which of the following schemes best describes Hubel & Wiesel’s
   hierarchy of receptive fields? Key to numbers below.
   a) 2, 4, 3, 1, 5
   b) 1, 3, 5, 2, 4
   c) **2, 4, 1, 5, 3**
   d) 2, 5, 4, 1, 3

Types of Receptive Fields (use in question above)
   1. Complex cell
   2. Concentric center-surround
   3. Hypercolumn
   4. Simple cell
   5. End stopped cell

10. The human visual system responds to a wide range of spatial
    frequencies. In the periphery (far from fixation), we are more sensitive
    to which portion of this range:
    a) Higher spatial frequencies.
    b) Mid-range spatial frequencies.
    c) **Lower spatial frequencies.**
    d) All spatial frequencies equally.

11. Which of the following occurs at the earliest level of processing?
    a) Size aftereffect
    b) Tilt illusions
    c) **Negative afterimage**
    d) Mach card illusion

12. The horizontal lines in the figure below are straight and parallel but we
    perceive them as bowing out in the middle. This is an example of:

    ![Diagram](image)
    a) attraction
    b) repulsion
    c) a & b
    d) none of the above
13. Which of the following is true about the transmission of information from the eyes to the visual cortex? Choose the best answer.

a) Information from the left eye is received by the right hemisphere, whereas information from the right eye is received by the left hemisphere.

b) **Information from the left half of each eye is received by the left hemisphere, whereas information from the right half of each eye is received by the right hemisphere.**

c) Information from the left and right half of each eye is received by both hemispheres.

d) Information from the left half of each eye is received by the right hemisphere, whereas information from the right half of each eye is received by the left hemisphere.
BOOK 1 SHORT ANSWER QUESTIONS.

In your first book, answer 3 of these next 5 questions. Each is worth 4 points.

1. “It’s a miracle!” began the text of the Examiner describing the image below. Readers were instructed to stare at the “magical” image for a while, and then to look at a blank white wall, where they would see an image of Christ “gazing lovingly” at them.

(a) What is the name for the visual component of this phenomenon? What is its explanation?

(b) If you happened to focus on a white wall that is rather far away, what would happen to the image? What would happen if you focused on something very close to you? What principle do these last two observations reflect demonstrate?

(a) The “miracle” of the image of Christ is actually a negative afterimage. (1 point) Following extensive viewing of an image, the photoreceptors which had responded strongly become “fatigued” due to depletion of photopigment. When the stimulus is removed, the reduced response of these photoreceptors is interpreted as a change in firing, and thus an afterimage with the opposite polarity of the original stimulus is experienced. (1 point for some description of adaptation or fatigue)

(b) If you happened to focus on a far-off white wall, the image appears to lie on that wall and would seem large, taking up a great deal of space, while if you looked at something closer than the original image, say your hand, the image appears to lie on your hand and be very small. (1 point) These two observations reflect Emmert’s Law, the observation that the perceived size of an image on the retina is proportional to (varies with) perceived distance. (1 point)
2. Name two types of animal eyes that differ structurally from the human eye. Briefly describe their structure and how they function, using diagrams as necessary.

One type of animal eye that differs structurally from the human eye is the compound eye. (1 point) Common in the insect world, the compound eye consists of an array of tubelike structures, each with its own lens and photoreceptors. These tubes (ommatidia) are packed together side by side to yield good coverage of the visual environment. (1 point)

Another, more primitive example of an eye is that seen in the chambered nautilus. Like a pinhole camera (1 point), it consists of a small opening through which light passes, landing on a bed of photoreceptors at the back of the eye (1 point).

3. Because of the new use of high velocity bullets in the Japanese-Russian War or 1905, many soldiers survived penetrating bullet wounds to the brain. Japanese Ophthalmologist Tatsuji Inouye was able to map part of the brain in these soldiers using visual stimuli. What part did he map and what did he find (3 things)?

Japanese ophthalmologist Tatsuji Inouye mapped the visual field in soldiers who had suffered damage to the primary visual cortex (1 point), particularly along the calcarine fissure. He found that the visual cortex consists of an orderly, retinotopic map of visual space, with adjacent points on the retina mapped to adjacent parts of the cortex (1 point). The map was upside down and left-right reversed with the upper field in the lower part of the cortex and the left side of the world in the right hemisphere. (1 point) Furthermore, his investigation showed that the fovea is vastly overrepresented in the visual cortex (1 point).

4. Describe the connections needed to build an end-stopped cell using three complex cells and excitatory and inhibitory connections.

To build an end-stopped cell, three complex cells with adjacent receptive fields (1 point) of the same orientation selectivity (1 point) would be needed. The central complex cell would have an excitatory input to the end-stopped cell (1 point), while the flanking complex cells on either side of the center would be inhibitory (1 point). These same points can be made graphically.

![Diagram of complex cells and end-stopped cell connections]
5. This figure represents the preferred orientations found for a large sample of cells in a normal cat’s visual cortex. Make a similar drawing for the preferred orientations of cells in an adult cat that was raised from birth in an environment that had only vertical contours. What can you conclude from this experiment?

*If we looked at the preferred orientations of cells in an adult cat raised from birth in an environment with only vertical contours, we would see a pattern like the one below. (2) This indicates that the orientation selectivity of cells in cat visual cortex, far from being predetermined or innate, is in fact largely predicated on the cat’s early visual experience of the external environment. (2)*
SECOND BOOK

Put your name on a new blue book, number the book #2 and begin. You should take no more than 30 minutes to finish the multiple choice and short answer questions for this section

BOOK 2 MULTIPLE CHOICE QUESTIONS.

Choose the one best answer for each and write the question number and the answer letter in your blue book, one answer per line. For example

1. c
2. b
3. b
and so on

1. A patient with damage to area PPA will have
   a) Impaired object recognition but intact facial recognition.
   b) **Impaired recognition of houses, outdoor scenes and buildings**
   c) Impaired recognition of body parts
   d) Impaired object tracking

2. Binocular disparity refers to:
   a) Processing of information from the right and left visual fields by different hemispheres.
   b) **The difference between each eye’s view of a scene.**
   c) The difference in accommodation between the two eyes when focused on a surface.
   d) The separate inputs from each eye to each hypercolumn.

3. Which of the following is NOT true of color perception?
   a) **The green-sensitive cones respond most to green.**
   b) Trichromatic processing precedes opponent processing
   c) The spectral sensitivity of the red and green sensitive cones are very similar.
   d) The trichromatic color code cannot be inverted to recover the wavelength distribution

4. Covering one eye when viewing a visual scene:
   a) eliminates disparity and depth perception.
   b) eliminates disparity, stereopsis, and depth perception
   c) **eliminates stereopsis and disparity.**
   d) eliminates stereopsis and depth perception.
5. Complementary color afterimages provide support for which of the following?
   a) The theory that some “Super” women have 4 different color receptors
   b) That there are three type of receptors for encoding color
   c) **That color is encoded by an opponent process**
   d) That there is only one type of rod photoreceptor

6. Binocular cells
   a) are located in area MT of the brain.
   b) respond only after recognition of the image is complete.
   c) are unaffected by visual experience.
   d) **have a range of spatial offsets between receptive field centers in left and right eyes.**

7. Which of the following is LEAST LIKELY to be a functional benefit of motion processing.
   a) structure & form
   b) postural control
   c) **linear perspective**
   d) estimating time to contact

8. Motion parallax is a powerful cue to
   a) **depth**
   b) accretion & deletion
   c) spatial frequency
   d) object identity

9. The most effective adapting stimulus for generating a motion after-effect on a subsequently viewed, static test pattern would be
   a) **An inwardly moving dot pattern.**
   b) A checkerboard that repeatedly reverses contrast.
   c) A rotating spiral with blue and yellow arms of equal brightness.
   d) A moving pattern of flickering texture.

10. By summing small patches of sine waves of many different orientations and sizes you can create
    a) A square wave
    b) A rectangular bar
    c) A random texture
    d) **All of the above**
11. Cells that respond to mid level features, specifically object parts that are meaningless on their own, are found in which structure
   a) Lateral occipital cortex
   b) Inferotemporal cortex
   c) Area OPA
   d) Parietal cortex

12. When red text is placed on top of a green background of equal luminance it can be difficult to read. This is because
   a) The letters drop below the threshold of visibility
   b) The letters are invisible to non-opponent, center-surround cells
   c) The colors create distracting motions in the letters
   d) Color cells do not contribute to pattern recognition

13. End-stopped cells
   a) Can disambiguate the direction of line motion seen in an aperture
   b) Respond to the direction of the line ending independently of the orientation of the line
   c) Are less effective if the line ending results from occlusion
   d) All of the above
BOOK 2 SHORT ANSWER QUESTIONS.

In your second book, answer 3 of these next 5 questions. Each is worth 4 points.

1. What evidence from patient and fMRI research discussed in class suggests that there are 2 separate brain systems for the perception of faces and objects?

   *Some patients can recognize objects but not faces (prosopagnosia) while others can recognize faces but not objects (CK agnosia). fMRI reveals a face area (FFA) and a separate object area (lateral occipital area).* (2 points for each description)

2. How can we have blue-yellow opponent cells when the only cones we have available to make them out of are red, green, and blue? Make a drawing to explain.

   *Blue-yellow opponent cells get one input from blue cones (1 point), and the opposing (negative, 1 point) input from summing (1 point) R&G cones (1 point). Drawing is necessary and can make the preceding points graphically without any text. This is not a center-surround cell (-1 point).*

3. Describe a low-level depth detector based on binocular disparity. What makes it "low-level"? What would constitute a high-level analysis of depth? Give an example.

   *A low-level disparity tuned cell has a spatial offset between receptive field centers in left and right eyes (1 point). The two receptive fields are otherwise similar (same orientation preference etc.) (1 point) A disparity tuned cell is “low-level” because it calculates depth directly*
from image position on retina and doesn’t require any cognitive inference or top-down knowledge (1). A high-level analysis of depth would use top-down knowledge, such as depth from occlusion, linear perspective, texture gradient, or any of the others discussed in class (1).

4. Suppose we test two individuals in our laboratory, one has only green-sensitive cones, the other has only rods. In what ways would their vision be similar? In what ways would it differ?

Both individuals would be monochromatic – colorblind (2). The individual with only cones would have better acuity in daytime lighting condition than the individual with only cones (1). The individual with only rods would have better night vision (1).

5. Provide two pieces of evidence discussed in class that the part of the visual system that guides action is not the same as the one that guides awareness.

Blindsight: some individuals with no ability to report on stimuli in some parts of visual space can nonetheless correctly grasp objects or point to flashes of light in that region when asked (still without being aware of them) (2 pts). Using poker chips, we can construct a visual illusion in which the center chip appears to be bigger or smaller than it’s actual size. In this case, our finger and thumb position indicate the correct grasp size despite the perceived visual illusion (2pts).
THIRD BOOK

Put your name and student ID on a new blue book, number the book #3 and begin. You should take no more than 30 minutes to finish the multiple choice and short answer questions for this section.

BOOK 3 MULTIPLE CHOICE QUESTIONS.

Choose the one best answer for each and write the question number and the answer letter in your blue book, one answer per line. For example

1. c
2. b
and so on

1. Which of the following factors does not affect the reaction time in identifying target stimuli?
   a) Number of distractors
   b) Complexity of the stimuli
   c) Number of pre-attentively identifiable stimuli
   d) Familiarity of the stimuli

2. Which of following is true about attentional selection?
   a) Selection is only based on features.
   b) Feature integration theory predicts that features based on receptive field properties are processed with attention
   c) Feature bindings occur preattentively according to feature integration theory
   d) Unselected information is highly processed according to object integration theory

3. Which of following is true about spatial resolution of attention?
   a) Resolution of attention is coarser than resolution of vision
   b) As long as you can see items, you can count them.
   c) The region of selection has a fixed size at each eccentricity.
   d) Resolution of vision is coarser than resolution of attention.

4. Inattentional blindness
   a) is caused by a bilateral lesion to the parietal lobe.
   b) is the inability to report details of an object despite attending to the object.
   c) provides evidence for an “early selection” theory of attention.
   d) shows that an item must be selected by attention in order to reach awareness.
5. Which of the following is the implication of change blindness?
   a) We build up a representation by adding new information with each eye fixation
   b) Since the world is constantly changing it can serve as its own memory
   c) Only a few items we attend to are represented while others are not identified
   d) Low-level transient signals are necessary to detect changes

6. While you are watching your favorite TV show you do not notice a fly on the TV monitor. This is the example of ____________________.
   a) Inattentional blindness
   b) Object integration processing
   c) Crowding
   d) Change blindness
   e) Poor hygiene

7. Which of the following visual memory has the MOST limited capacity?
   a) Iconic memory
   b) Short-term memory
   c) Long-term memory
   d) Photographic (eidetic) memory

8. Which of the following visual memory has the MOST limited duration?
   a) Iconic memory
   b) Short-term memory
   c) Long-term memory
   d) Photographic (eidetic) memory

9. Neuropsychological evidence that the parietal lobe is involved in attention comes from:
   a) Motion blind patients.
   b) Capgras syndrome.
   c) Balint’s syndrome.
   d) Hydrocephalus

10. Visual neglect
    a) provides evidence for a separate subcortical visual pathway.
    b) results from damage to both parietal lobes.
    c) is present even in the mental imagery of neglect patients.
    d) is the inability to see items the left visual field.
11. Following damage to the right parietal lobe, a person would be most likely to show which of the following symptoms?
   a) An inability to recognize faces
   b) A delusional belief that familiar people are “alien imposters”
   c) **A failure to eat food on the left half of their plate**
   d) Blindness in their left visual field.

12. The concept of blindsight refers to:
   a) consciously seeing objects but not recognizing them
   b) **a dissociation between conscious visual perception and performance in visuo-motor tasks**
   c) normal people's incapacity to notice change in visual stimuli when their attention is diverted
   d) an extreme example of change blindness

13. Information is transferred from one visual memory system to another through a variety of processes. Which of the following is incorrect?
   a) From iconic to explicit short term: attention
   b) **From iconic to subliminal memory: unconscious arousal**
   c) From short term to explicit long term: rehearsal
   d) From iconic to implicit memory: mere exposure
BOOK 3 SHORT ANSWER QUESTIONS.

In your third book, answer 3 of these next 5 questions. Each is worth 4 points.

1. Name and describe two examples of brain damage that result in attentional deficits. How do these deficits differ from blindsight (in the left visual field)? What brain regions are damaged in each of these three cases?

   **Neglect:** Unilateral damage to the parietal area (usually right parietal) (1/2 pt), results in the failure to attend to objects or body parts contralateral to the damaged area. (1/2 pt),

   **Balint:** Bilateral damage to the parietal area (1/2 pt), results in the inability to attend to more than a single object at any one time (1/2 pt).

   **Blindsight (left visual field):** Damage to right area V1 (1/2 pt), resulting in blindness (inability to see) for information presented in the left visual field. Despite this blindness, however, it has been shown that blindsight patients can reach and adjust their grip appropriately to grasp objects in their blind field (1/2 pt).

   The attentional deficits are different from blindsight in that neglect and balint patients can see neglected visual information, but tend to ignore it, whereas blindsight patients do not have conscious perception of visual information. (1pt)

2. Many experiments have shown that our attention can move independently of our eyes. Explain the advantages of this independence and give an example from the lectures.

   **Advantages**

   1) If you must keep track of more than one object, and those objects are moving independently of each other, it is impossible to keep your eyes focused on both objects (1/2 pt), so it is important to be able to attend to and keep track of the object with “covert” attention (attention away from the fovea) (1/2 pt).

   2) People are really good at detecting whether or not a person is looking directly at them (1/2 pt). Thus, if you wish to monitor what another person is doing without them knowing that you are doing so it
is necessary that you are able to attend to them without looking directly at them by shifting the focus of your attention away from the fovea (1/2 pt).

Examples (one needed)

1) Multiple object tracking: it is possible to keep track of 4 or 5 out of 10 identical moving objects. Because all of the objects are identical, the only way to keep track of them is by continuously attending to them. Since more than one object is tracked, some must be followed independently of where the eyes are focused. (2 pts)

2) Spatial attention: if we see a ring of letters which are briefly presented, then shifting our attention to the left will allow us to report the letters on the left, but not the letters on the right. Given the exact same display, shifting our attention to the right will allow us to report the letters on the right, but not the letters on the left. (2 pts)

3. The graph below presents some typical results from visual search experiments.
   a) Name the horizontal and vertical coordinate axes, giving appropriate units.
   b) Match the following descriptions to each line on the graph. Answer in number letter pairs, 1a, 2b, etc.
      1) Pre-attentively detected pattern with target stimulus absent.
      2) Attentively detected pattern with target stimulus present
      3) Attentively detected pattern with target stimulus absent.
      4) Pre-attentively detected pattern with target stimulus present
4. Compare between object integration theory and feature integration theory. Provide supporting evidence for each theory and specify when attention is necessary in each theory.

**Feature Integration Theory**
Only simple properties, like those detected by v1 neurons, are processed preattentively (1 pt). This explains why search time for a target defined by one of these basic features (e.g., vertical among horizontal) will be independent of the number of distractor items in the display (1/2 pt), but targets that are not defined by such properties (e.g., an object with red on the left and green on the right) require attention to combine the features of an object and identify them (1/2 pt).

**Object Integration Theory**
According to object integration theory, the set of “preattentive” features that are available is not limited to simple receptive field features like spatial frequency and orientation. Instead, items are highly processed, even at the preattentive level (1 pt). Thus, the “bumps” and “dents” derived from global scene shading can be computed and made available preattentively (1/2 pt). However, despite this high level of preattentive processing, some features of an object’s identity might not be explicit preattentively (e.g., an whether the red part is on the left or on the right of the object), and computing these aspects of the object’s identity requires attention (1/2 pt).

5. How do implicit visual memories differ from explicit memories? Describe an experiment that demonstrates implicit visual memory.

Explicit visual memories are those that we can consciously recall or recognize (1 pt), whereas implicit visual memories affect our behavior (e.g., response time or accuracy in some task), but cannot be recalled explicitly (1 pt).

One experiment that demonstrates implicit memory took advantage of inattentional blindness. In this experiment, observers focused their attention on a cross and judged whether the vertical or horizontal line
segment in the cross was longer. During one trial of this task, a word was briefly presented on the screen (e.g., “GRACE”), but because their attention was engaged in the cross task (1/2 pt), most observers failed to report noticing the word, and could not explicitly recall what the word was (1/2 pt). However, when later given a word stem completion task (e.g., finish this word: GR_ _ _) many observers filled in the missing letters corresponding to the word that could not be explicitly reported (ACE in this case) (1/2 pt), which indicates that they had an implicit memory for the word which they could not report, but which nevertheless had an effect on their behavior in the word stem completion task (1/2 pt).
FOURTH BOOK

Put your name and student ID on a new blue book, number the book #4 and begin. You should take no more than 30 minutes to finish the multiple choice and short answer questions for this section

BOOK 4 MULTIPLE CHOICE QUESTIONS.

Choose the one best answer for each and write the question number and the answer letter in your blue book, one answer per line. For example

3. c
4. b
and so on

1. Which of the following cues rules out amodal completion?
   a) L junctions
   b) T junctions
   c) X junctions
   d) Z junctions.
   e) All of the above.

2. The “pac men” of the Kanizsa subjective triangle
   a) are seen at the same depth as the subjective figure.
   b) each amodally complete behind the triangle.
   c) own the borders between the pacmen and the triangle.
   d) are seen in front of the triangle.

3. Which of the following definition is NOT correct?
   a) Highlight: a reflection on a shiny surface
   b) Apparent motion: a motion stimulus with discrete steps in time and space
   c) Biological motion: an action pattern that helps recognize and then animate the perception of a familiar motion
   d) Shading: the variation in reflected light due to the change in the orientation of the surface.

4. In the example here, many see the central square as a transparent. In this case, the visual system interprets
   a) an L junction as a corner.
   b) an L junction as a T junction.
   c) a T junction as an occlusion edge.
   d) a T junction as an X junction.
5. Which of the following is NOT true?
   a) A camouflaged T junction implies modal as well as amodal completion
   b) If the world consisted of only black and white objects, modal completion would occur less frequently than it does
   c) Whenever modal completion occurs amodal completion occurs
   d) Amodal completion allows fragments to be grouped.

6. Which of the figures below has the strongest modal completion? (use the drawing’s letter a through e as your answer) **Answer: d**

7. Which of the following pictures is NOT an example of a border ownership dispute? **Answer: a**

8. Which of the following is an example of figure-ground reversal?
   a) The Necker Cube
   b) **The face vase illusion**
   c) The motion aftereffect
   d) The duck-rabbit illusion

9. As discussed in lecture a brain area implicated in the perception of subjective contours is
   a) MT
   b) MST
   c) V1
   d) **V2**
   e) V4
10. For a pattern to be seen as a reflection, it must obey which of the following rules
   a) Reflections must not make X junctions like shadows
   b) Reflection luminance must equal that of the surrounding surface
   c) Reflections must match the scene they reflect
   d) **Reflections must not be random patterns**

11. Gestalt laws of grouping discussed in class included all of the following EXCEPT:
   a) Proximity
   b) Similarity
   c) **Genericity**
   d) Good continuation
   e) Good form

12. The rules of border ownership include all of the following EXCEPT:
   a) When two regions meet, only one can own the border between them
   b) The region taken to be in front owns the border
   c) If a region does not own part of its border, then it is unbounded.
   d) **A bounded region can connect to other bounded regions to form larger surfaces.**

13. The interpretation of this image as a partially hidden horse is an example of
   a) Object knowledge
   b) **Good continuation**
   c) Modal completion.
   d) Good form.
BOOK 4 SHORT ANSWER QUESTIONS.

In your fourth book, answer 4 of these next 6 questions. Each is worth 4 points.

1. One could identify a dark area as a shadow by noting the direction of the light, the shape of the object casting the shadow and the "topography" (bumps, folds, etc) of the surface on which the shadow falls. Does the visual system use this strategy? Support your answer with a description of two different observations from experiments, art, or everyday events.

   No, the visual system does not use these actual optical determinants of shadows to recognize what is a shadow and what is not. (2 points) One example is the doctored photo of Lee Harvey Oswald that has shadows based on inconsistent lighting. We do not perceive the shadows as incorrect, if we notice them at all, and we only find the lighting inconsistencies with analysis. (1 point) Another example comes from the picture has a shadow without an casting object This example shows that shadow can have inappropriate shape yet be regarded as shadow. (1 point)

2. The picture below was discussed in the section dealing with ambiguous figures (can you see the two interpretations?). Focus for the moment on the interpretation of the woman in front of the mirror. Where is the woman looking? Given that the painting is titled “Vanity” could the artist have made an error in depicting the position of the woman and her reflection? Does it matter? What is the error and what does it tell us about the visual system?
According to the geometry of reflections, for us to see the woman's reflection in the mirror as we do here, she must be looking off to the side (1); yet, given that the painting is titled "Vanity", and that she is seated at a dressing table, we assume that she is actually looking at her own reflection (1). The incorrect depiction of the geometry of her reflection is a common painting error, here being exploited to make an allegorical point (1). Yet we don't normally notice the problem, suggesting that our visual system is insensitive to how the geometry of reflections works. (1)

3. Can you make a white piece of paper look black? How and why?

Yes, by misleading the visual system about the intensity of light falling on the paper. (2) The observer receives the product of a paper's reflectance and the intensity of the incident light and recovers the reflectance by discounting the illuminant. (1) In Gilchrist's room, for example (the two discs of the classroom demonstration are good as well) the intensity of the light is inferred based on apparent location in space. By removing a corner of the target square, the target is made to appear in either dimly lit front room or the brightly lit far room. Although the target and the light coming from it never change, observers see it as white when it is apparently in the front room and dimly lit but dark gray when it appears to be in the back room and brightly lit. (1)

4. A recent analysis of Caravaggio’s painting showed that over 75% of them have strong lighting from the left (the viewer’s left while looking at the painting). The people depicted in these paintings are judged to have stronger emotional expressions than those in paintings lit from the right. Give an explanation of this observation based on material discussed in the lectures.

In the lecture we saw a simple outline drawing of two faces with crooked expressions. When looking at their noses, most of us judged the face with the smile on the left side as happier than the face with the frown on the left side (1). The two faces were identical except that they were mirror images. Results like these have been used to suggest that the amygdala in the right hemisphere is more sensitive to facial expressions (1). In the drawings, the left side is the one that dominates the overall expression and this is the side that projects the right amygdala (1). Similarly, because in Caravaggio’s paintings lit from the left, the left side of faces of people in the painting who are looking at us get stronger lighting whereas their right sides are hidden in
shadow. These left sides of the faces are processed in the viewer’s right amygdala, and thus has greater emotional strength (1).

5. Since the time of Zeuxis (about 400 BCE, who can forget him), cast shadows have been added to paintings to enhance realism. What do shadows contribute that helps us to understand the three-dimensional structure of a scene? Explain your answers; use drawings if you wish.

Shadows tell us about the relative placement of objects (ordinal, not metric) and about the relief of the surface on which they fall (2). Shadows place objects relative to the surface on which they cast their shadows. If shadows are removed, objects float ungrounded. If a shadow is in contact with the object that casts it, then the object rests on the shadowed surface. If there is a gap, the object floats over the surface. Distance between the object and the shadow it casts indicates the distance between the object and the shadowed surface (1). Shadows add extra contours to the surface on which they fall and these shadow borders can then reveal folds and bumps on that surface. (1)
FIFTH BOOK

Put your name and student ID on a new blue book, number the book #5 and begin. You should take no more than 30 minutes to finish the multiple choice and short answer questions for this section

BOOK 5 MULTIPLE CHOICE QUESTIONS.

Choose the one best answer for each and write the question number and the answer letter in your blue book, one answer per line. For example

5. c
6. b
and so on

1. The image at right provides an example of depth from
   a) linear perspective
   b) texture gradient
   c) atmospheric perspective
   d) height in field

2. Which of the following is not a cue for scene depth:
   a) Occlusion
   b) Object knowledge.
   c) Retinal image size.
   d) Atmospheric perspective.

3. Which of the following pictorial cue is NOT metric?
   a) Linear perspective
   b) Occlusion
   c) Height in field
   d) Known size
   e) Atmospheric Perspective

4. Which of the following is NOT true about the impossible triangle?
   a) It can be an accidental view of a real 3D object.
   b) Locally, everything seems reasonable.
   c) Globally, it is perceived as a jumble because it does not make sense.
   d) It’s just your brain, trying to make the best story it can
5. Which of following is NOT true about tracking?
   a) Tracking requires attention
   b) We have independent left and right hemifield resources for tracking
   c) Parietal lobes are activated during tracking
   d) Tracking requires low-level motion

6. An example of a motion stimulus that requires a high-level motion system to be registered is:
   a) Apparent motion over large distances.
   b) Bars drifting smoothly.
   c) Reverse motion.
   d) The motion aftereffect.

7. Recall the Ames room display in which two people stand on opposite sides of the room. One person appears smaller because he or she
   a) actually is smaller than the other person
   b) has a larger visual angle, so size constancy causes him to appear smaller
   c) has a smaller visual angle than the other person but appears to be at the same distance
   d) has the same visual angle as the other person but is actually much further away
   e) perceived distance changes but his visual angle does not

8. All of the following statements about the apparent motion quartet are true EXCEPT
   a) Color is not an important factor in determining the perceived direction of motion.
   b) Patients with parietal lobe damage cannot distinguish the motion from flicker.
   c) The perceived direction of motion is unaffected by top-down models of action.
   d) When there are multiple quartets, they switch direction of motion as a group.

9. Which of the following is not a monocular source of depth information?
   a) vergence angle
   b) accommodation
   c) aerial perspective
   d) linear perspective
Alert: The following question is worth 4 points

10. For each type of deficits on the left, indicate the brain area where you can find a damage. Select only one best set of pairings for each. Write the letters and numbers as pairs e.g. a 3, b 5, etc.

   a) Neglect   1) Both parietal lobes
   b) Balint’s syndrome  2) Amygdala
   c) Capgras syndrome  3) FFA
   d) Prosopagnosia  4) Lateral occipital cortex
   e) Visual agnosia  5) Corpus callosum
   f) Split brain syndrome  6) Right parietal lobe
   g) Blindsight  7) MT
   h) Motion blindness  8) V1

   a 6, b 1, c 2, d 3, e 4, f 5, g 8, h 7
BOOK 5 SHORT ANSWER QUESTIONS.

In your *fifth* book, answer 3 of these next 6 questions. Each is worth 4 points.

1. When presented with an apparent motion stimulus, usually our visual system picks the shortest path. Give an example where the visual system *doesn’t* choose the shortest path and explain why.

   *In the quartet stimulus, the perceived motion typically follows the shortest path (picture). For example, if the vertical separation is less than the horizontal separation, we see vertical motion. However, if we then gradually decrease the horizontal separation until it is actually less than the vertical separation, we continue to see vertical motion, which is actually not the shortest path any more (2 points). This occurs because not only distance but also history influences our perceived motion in this stimulus. The prior history of seeing vertical motion relied on an internal model of a vertical trajectory this biases our perception even though the vertical distance is not the shortest path any more (2 points).*

2. Name and describe 4 depth cues in the following picture.

   *Occlusion: the person occludes the building, forming many T junctions where the building contours run behind the him so the person is perceived as being front of the building.*
Shadow: The gap between the person and his shadow on the plaza tiles is a good cue that the person is floating above the ground.

Texture gradient: The change in size of similar objects gives the depth cue. In the plaza, the tiles reduce their size going upwards in the image indicating that the distance to the tiles is increasing.

Known size: Many objects in this scene are familiar ones with familiar sizes (e.g., a building is much bigger size than a person) and this is used to determine distance to the objects.

Height in field: Since we assume a flat, level-ground plane here, height in field corresponds to distance. An object higher in field, for example, is farther away. In this picture the building is higher in the filed of view than the tiled plaza so the building should be farther away than the floor.

3. Describe and explain a situation where a reversal in apparent depth creates an erroneous impression of motion during head movement.

Santa, Hollow mask, Mach card, small wire basket

When the Mach card is placed on a table lying on its bottom two folds, like a W, we can perceptually flip it so that the folds appear to stand on end like an M viewed from the top, with the top two ridges facing us. Because the depth is reversed, as we move our head to the side, the shape must appear to move in the same direction that we are moving to keep up with the changes in the view we now have of the object (2 points). For example, the left side of the card that should come more into view as we move our head to the left actually becomes viewed from a sharper angle with the depth reversed. The only way to explain this changing view is to perceive the Mach card in motion itself, in the same direction but actually overtaking our head motion. (2 points).

4. In the Muller-Lyer Illusion, the vertical line on the left is judged as being shorter than the vertical line on the right. In the Ponzo Illusion the horizontal line above appears larger than the horizontal line below. In both cases the lines are actually the same length. Provide a single explanation that can account for both of these illusions.

Both illusions can be explained by implied depth (2 points for mentioning implied depth). In the Muller-Lyer illusion, the central
shaft with the arrow heads flipped inward appears shorter than the shaft with the arrow heads flipped outward. The arrow heads are cues to depth as they match the pattern seen for a protruding, outer corner and a receding, inner corner. Protruding corners are usually closer than receding corners, so in correcting the size of the shaft for the implied distance, the protruding corner, being closer and with the same length on the retina, would be seen as shorter. The receding corner, being farther away but having the same length on the retina, would be seen as larger (1 point). Similarly, the top line in Ponzo illusion looks longer than the bottom line. The two oblique lines converging at the top gives a cue to implied depth that the top line is farther away than the bottom line. Because both lines have the same size on the retina, in correcting the size for the implied distance, the top line, being farther away would be seen larger (1 point).

5. Briefly explain why the activity of low-level motion detectors cannot be easily used to keep track of an object’s direction and speed as it moves.

When several objects move in the visual field they will activate many low-level motion detectors that have receptive fields in those locations. To select the motion detectors that give the appropriate motion signals for one particular object we need to know where that object is and read out only the receptive fields that lie on or within that object’s boundaries (2 points). However if we have to know the position of the object on a moment by moment basis, there is no need to read out low-level motion since we can easily determine speed and direction from the object’s moment to moment path (2 points). The information from the low-level motion detectors is therefore redundant with the information required to retrieve it.

6. Provide a brief definition of constraint satisfaction and how it applies to the interpretation of an image or object.

A local cue, an informative part of an image, gives rise to a set of possibilities (1 point). Each possibility constrains the assignment of surfaces and edges around the cue (1 point). The final interpretation of the image is the one that is most compatible with “all” the cues (1 point). This is called constraint satisfaction. The final interpretation satisfies the most constraints. Usually only a few are enough to find a good solution. Evidence is that only a few are checked within a local region. It allows many different regions to be analyzed in parallel and rapid determination of depth over whole scene. However, the cost of this efficiency is that inconsistencies across regions are not noticed. (1 point)
SIXTH BOOK

Put your name and student ID on a new blue book, number the book #6 and begin. You should take no more than 30 minutes to finish the multiple choice and short answer questions for this section

BOOK 6 MULTIPLE CHOICE QUESTIONS.

Choose the one best answer for each and write the question number and the answer letter in your blue book, one answer per line. For example

1. c
2. b
and so on

1. In a pile of your laundry you recognize your favorite sweater. What method did you use to do this?
   a) Template matching.
   b) Structural analysis.
   c) Biederman’s Geons
   d) **Distinctive Features.**

2. Which of the following is NOT true about vision development?
   a) Visual acuity matures by 6 months
   b) Pictorial depth cues are available 21 weeks
   c) Shared attention is available by 1 month
   d) **Gravity rule can be applied appropriately at 2 years**

3. Which of the following is NOT true about gestures?
   a) We unconsciously reproduce the posture and gestures of friends
   b) **Conscious, meaningful gestures are mostly universal across cultures**
   c) Unconscious gestures are similar across cultures
   d) Gestures and postures carry messages

4. Which of the following is NOT a criterion for selecting Biederman’s geons?
   a) Sufficiency
   b) Reliable even in noise
   c) Discriminable
   d) **Defining properties are view dependent**
   e) Reliable when partially obscured
5. Which of the following processes is explained by Biederman’s theory of shape recognition?
   a) We can quickly distinguish between Harrison Ford and John Travolta
   b) We can notice the difference between wool and silk
   c) We can find chairs in a dining hall
   d) We can recognize objects based on distinctive features

6. Which of the following is NOT true for the language of vision?
   a) Actions are equivalent to verbs
   b) Spatial and temporal relations are equivalent to prepositions
   c) Messages to the rest of the brain can be images or movies
   d) Sending visual language messages to nonvisual areas requires attention

7. Which of the following is NOT true for production and perception of facial expression?
   a) Perception of facial expressions is universal since they are understood in the same way across cultures
   b) Perception of facial expressions is innate since infants respond to facial expressions of others at an early age
   c) Production of facial expressions is innate since congenitally blind children can produce the same facial expressions
   d) Production of facial expression is universal since similar facial expressions can be found in other species

8. Which of the following is NOT evidence of an independent route for emotional response?
   a) Rapid analysis of emotion content of scene happens even when the presentation is too brief or indistinct for conscious perception
   b) Amygdala shows strong responses to brief, low spatial frequency images of fearful faces which produce poor responses in FFA
   c) Damage to amygdala may cause the Capgras syndrome
   d) Ability to read facial expression is sensitive to facial orientation

9. The delusional belief that members of your family are imposters is a symptom of which of the following? (Choose One)
   a) Balint Syndrome
   b) Neglect
   c) Capgras Syndrome
   d) Prosopagnosia
BOOK 6 SHORT ANSWER QUESTIONS.

In your sixth book, answer 4 of these next 5 questions. Each is worth 4 points.

1. In what way are axes important in Biederman’s Recognition by Components theory? Draw an example where changing the assignment of axes makes the item a different object.

   Each geon is assigned an orientation (up-down, front-back). The spatial relations between geons (on top, left, in front) are also part of the object’s description. (2 points for a description of both aspects of axes, geons, and geons within objects). Some objects change identity when top and bottom or front and back are exchanged. Examples: duck/rabbit or ice cream cone / dunce cap, or bucket / helmet, other examples also acceptable. (2 points for appropriate drawing.)

2. Briefly describe the structural approach to object recognition and give one example that shows that we can recognize an object based on structure and that the shapes of its parts do not matter.

   This approach is based on the relationships between parts of the object (the structure) (1 point) and not the shape of parts or the exact shape of the object (1 point). The shape of parts does not matter: the face made of fruit still seen as face due to the structural relations of parts. Fact that face parts made of from fruit does not hamper ability to recognize whole as face. (2 points for the fruit face or other suitable example).

7. Briefly describe the template model of object recognition and two major limitations of this model.

   Template model of object recognition: match shape you are looking for against each shape in an image (2 points). Problems. 1) Specificity: templates specific to size and orientation, 3D view point, and variant (fonts, types of chairs) so need a template for every version of an object. 2) Processing and memory: Need many templates (memory storage problem) matched against all image locations, all at once (processing problem). (1 point for each reasonable limitation)

4. What is shared attention? Describe an experiment showing shared attention in infants.
Shared attention is the ability to notice where others are attending and attend there as well. (1 point) Experiment: Present infant with display of a face. The face then looks either left or right. (1 point) Then present babies with 2 rectangles, one on the left, one on the right. (1 point) Infants look longer at the rectangle on the side the face had looked at. (1 point)

5. Previous researchers have hypothesized that babies from a young age have preference for looking at faces. You design an experiment to test this hypothesis on 1 month-old infants, selecting your stimuli from among the ones shown above. Your answer should include a description of the experimental technique, the stimuli you chose, and expected results.

The experimental technique is preferential looking where two stimuli are presented at the same time and observers record the looking time of the baby for each of the two stimuli. (1 point, looking time also OK if a sequential presentation is described). Best stimuli choice is 1 & 3 to compare face and non face while keeping other properties the same (color, features, etc). (1 point each for 1 and 3) Results: – the baby should look more at the face stimulus, #1, than the scrambled face showing that they can tell the difference. (1 point). A more complete experiment would compare #1 against 2, 4, and 5 (each paring tested individually) to show the babies prefer faces to these alternatives and then #3 against again 2, 4, and 5 to show this preference was based on the face and not the colors or other features present in both the face and its scrambled version. This more complete experiment will impress us but will not get any more points.

Remember answer 4 of these 5 questions.