

First name: _____ Last name: _____

Student number: _____ Signature: _____

UNIVERSITY OF CALIFORNIA, San Diego
Department of Cognitive Science

COGS 101A (Sensation and Perception)

Instructor: Virginia de Sa

Midterm 2-Version 1 (There are 2 subtly different versions)
November 16, 2004

Duration: 80 minutes

No aids allowed. Everyone must work individually; all questions should be directed to the Professor or TAs. There are two subtly different versions of this test.

This examination paper consists of 9 pages and 28 questions. Please bring any discrepancy to the attention of the instructor. The number in brackets at the start of each question is the number of points the question is worth.

Answer all questions.

Please show your logic. Partial credit will be given for reasonable attempts — put down what you can. Full sentences are not required but clear logical presentation is. Read all questions before starting. Do the easiest questions first. Good luck!

For instructor's use:

	Score
1 (3)	
2 (1)	
3 (2)	
4 (6)	
5 (3)	
6 (2)	
7 (2)	
Subtotal	

	Score
8 (3)	
9 (4)	
10 (4)	
11 (3)	
12 (2)	
13 (3)	
14 (4)	
Subtotal	

	Score
15 (2)	
16 (3)	
17 (5)	
18 (1)	
19 (1)	
20 (2)	
21 (1)	
Subtotal	

	Score
22 (4)	
23 (1)	
24 (2)	
25 (1)	
26 (3)	
27 (2)	
28 (0)	
Subtotal	

Total (70)	
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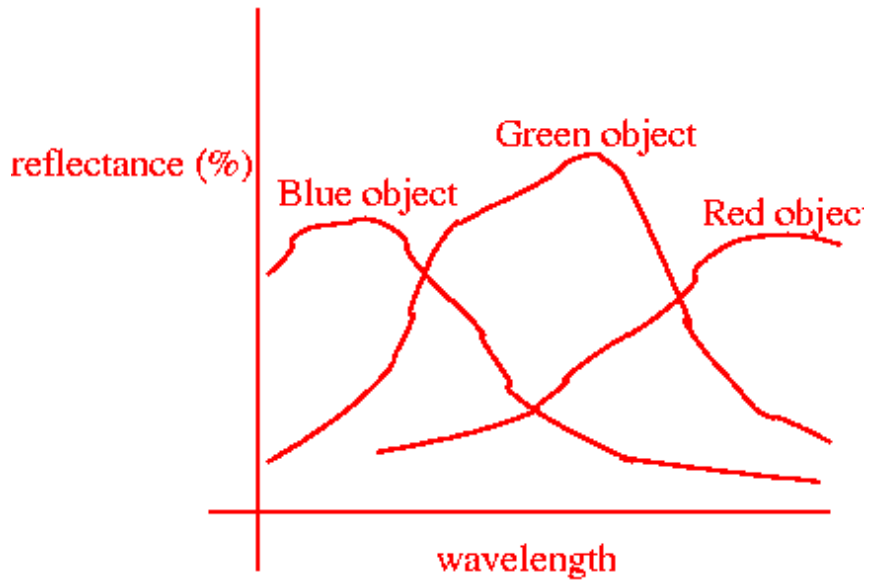
1. [3] Fill in the two blanks and circle one of dorsal or ventral in the last sentence.

The **koniocellular** pathway transmits information about blue vs yellow distinctions. The parvocellular pathway transmits information about **red/green** distinctions. The parvocellular pathway is the major input to the (**dorsal/ventral**)[circle one] pathway.

2. [1] Circle the correct option within each set of parentheses

(**Red/blue**)[circle one] is longer wavelength than (**red/blue**)[circle one].

3. [2] Draw your best estimate of a reflectance curve for a green object. On the same graph also draw your best estimate of a reflectance curve for a red object and a blue object. Label each appropriately. Label the axes appropriately. You do not need to put numbers on the axes but should cover the whole visible spectrum (and only the whole visible spectrum).



4. (a) [1] Describe the experiment that was used as evidence for the Trichromatic theory of color vision? (in 3 sentences or less)

Subjects were able to match the perceived color of one wavelength by adjusting the intensity of three other wavelengths

- (b) [1] What is the physiological (neural) evidence for the Trichromatic theory of color vision?

We have 3 different cone types (long wave, medium wave and short wave sensitive).

- (c) [1] Describe the experiment that was used as evidence for the Opponent-process theory of color vision? (in 3 sentences or less)

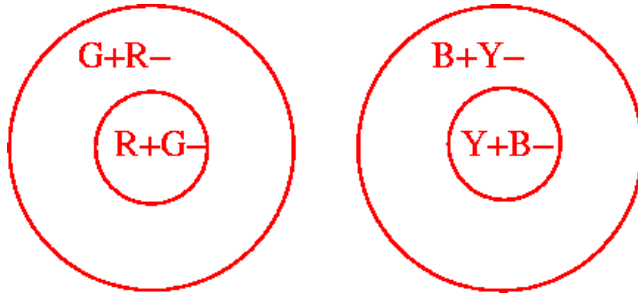
The afterimage of red is green and vice-versa. The afterimage of blue is yellow and vice-versa. This was used as evidence that they are opposite perceptions

- (d) [1] What is the physiological (neural) evidence for the Opponent-process theory of color vision?

There are opponent neurons that respond with excitation to red and inhibition to green (and vice-versa). Likewise for yellow/blue

- (e) [1] Draw an example receptive field for a double opponent neuron.

Either of these is fine. You can also switch R for G and vice-versa or switch B for Y and vice-versa



- (f) [1] Where is a neuron with this kind of receptive field found?

Area V1 and V2 (either answer acceptable)

5. [3] Fill in 3 blanks

Color constancy is the ability to recognize the same **color** under widely varying **illumination or lighting** conditions. Give the name of the cortical area associated with color constancy **V4**.

6. (a) [1] What is an anomalous trichromat?

A person with three cone types but where the sensitivities of the L and M cones are shifted closer together

(b) [1] How do you test for this (and what outcome does an anomalous trichromat give)?

You can have them do the color matching experiment mentioned in answer 1 a). The anomalous trichromat would give different intensity values on the three matches but would be able to match

7. [2] Fill in the blanks with 1 to 3 words each

Rabbits have lateral eyes (on the side of their head) but humans have frontal eyes (in the front of their head)

Lateral eyes are better than frontal eyes for **greater field of view**. Frontal eyes are better than lateral eyes for **stereo vision (depth perception is also a good answer)**.

8. (a) [1] Circle the correct option

In the lab, you created an afterimage and then looked at a faraway wall and a near surface. The afterimage looked larger when you were looking at the (**far away wall/near surface**)[circle one].

(b) [2] Give the equation that explains this phenomenon AND explain how it applies to the situation in part a).

$$S = k(R \times D)$$

where S is perceived size, k is a constant, R is size on the retina and D is perceived distance

When you have an afterimage, you are detecting a bleached region of the retina. This stays the same size in the two conditions. When you are looking at the far wall, you perceive distance as far (larger), and thus perceived size is relatively larger than when you are looking at a close object and perceive distance as close (smaller).

9. [4] Give four depth cues (either by name or description) and state for each whether it is an oculomotor cue, monocular cue, or binocular cue.

There's a long list in the notes. For oculomotor: convergence, accommodation. For monocular: occlusion, relative height, relative size, cast shadows, familiar size, atmospheric perspective, linear perspective, texture gradient, motion parallax, deletion and accretion. For binocular depth cues: binocular disparity/stereopsis.

1. _____
2. _____
3. _____
4. _____

10. [4] Fill in two blanks and circle one option from each of the two sets

Points on the horopter fall on **corresponding** points on the two **retinas or retinae**. For objects located farther than the horopter, their images move (**towards the nose/away from the nose**)[circle one] on the retinas. This is called (**crossed/uncrossed**)[circle one] disparity.

11. (a) [2] Fill in two blanks (with 1 to 3 words) In order to perceive apparent motion the ISI must be in the correct range. If the ISI is too long, you see **successive flashes**. If the ISI is too short, you see **flicker or simultaneous flash**.

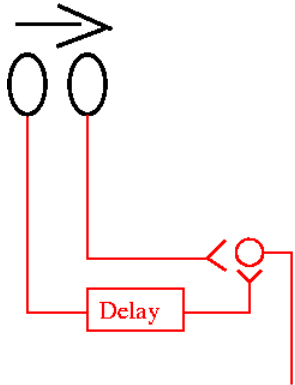
(b) [1] Fill in the blank

Another factor that influences the exact range of ISIs that give the perception of apparent motion is **the distance between the flashes**.

12. [2] What is the “shortest path constraint” ? AND when can it be violated? (for full marks on this one, give the important details of the stimulus and presentation timing)

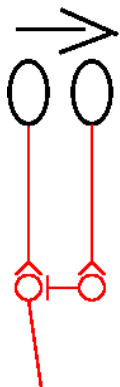
The shortest path constraint says that the motion follows the shortest path between the dots. It can be violated with longer presentation times when the shortest path doesn't make sense.

13. (a) [2] Draw a Reichardt motion detector that detects motion to the right. You may use the two receptors shown below (your circuit need only contain two receptors). You may draw the circuit from the book or from the lecture slides.



(b) [1]

Draw the other Reichardt motion detector that you didn't draw above (from the book or lecture slides). Your circuit need only contain two receptors.



14. (a) [1] Fill in the blank with a few words

In the corollary discharge theory, motion on the retina is compared to **eye movement command** in order to determine if motion is perceived.

(b) [2] Give an example of an experiment where motion is perceived **even though there is no motion across the retina (no retinal slip)**. Explain how it is compatible with the corollary discharge theory.

There are four examples that we talked about (any 1 would do (or another that fits the criteria)).

- i. paralyze your eye muscles and try to move them - then the eye motion command signal is issued but there is no retinal slip and so motion is perceived.
- ii. fixate an object and press (gently) on the side of your eye. Your eye muscles act to keep the eye fixated and there is no retinal slip and motion is perceived.
- iii. track a moving object with your eyes. There is no movement across the retina, but the eye muscles are activated and motion is perceived.
- iv. observe an afterimage as you move your eyes (in a dark room). The afterimage is fixed on the retina so there is no retinal slip. There is an eye movement command and motion is perceived.

(c) [1] Give an example of a situation where motion is not perceived. Explain how it is compatible with the corollary discharge theory.

Note that eye movement commands and retinal movement only cancel when they are equal and opposite.

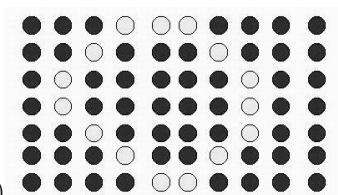
Two easy examples are:

- i. fixate a static object – no eye movement command, no retinal slip.
- ii. move your eyes across a static scene - retinal motion is equal and opposite to eye movement command

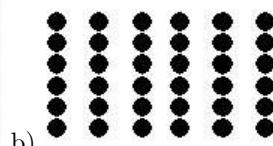
15. [2] Circle the correct options (one from each set)

When observing a moving plaid stimulus, neurons in (**V1/MT/LGN**)[circle one] tend to respond to the direction of the individual components of the plaid. Neurons in (**V1/MT/LGN**)[circle one] tend to respond to the direction of the pattern (the perceived global direction of motion).

16. [3] Give the Gestalt law (or heuristic) associated with each of these three images. (one each) (If you don't remember the exact name state the idea.)



a) Law of Similarity



b) Law of Proximity



c) Law of Meaningfulness or Familiarity

17. [5] Put an M, T or B beside these terms to say which model/theory they most relate to (Marr's computational model, Treisman's feature integration theory, Biederman's recognition by components)
- (a) Illusory conjunctions **T**
 - (b) Primal sketch **M**
 - (c) $2\frac{1}{2}D$ sketch **M**
 - (d) Geons **B**
 - (e) Popout **T**
18. [1] Fill in the blanks
Illusory conjunctions occur when there is insufficient **time** to **combine** features.
19. [1] What is the occlusion heuristic?
We see an occluded object continuing behind the occluder
20. [2] Give an example of a top-down effect influencing object perception and explain why it is a top-down effect.
Any of the examples where something not in the input influences your perception. e.g. The Coca-cola example where you read it as Coca-cola because that is what you are used to. This is a top-down effect because our perception is changed due to some aspect that is not in the stimulus.
Another example is when you see the young woman (in the ambiguous old woman/young woman picture) when you have been primed towards young (and the old woman when you are primed towards old). This is a top-down effect because the exact same bottom up input is seen in two different ways depending on the state of the person.
21. [1] Geons are 3-Dimensional volumetric primitives. Describe one feature of geons that reveals how they were determined.
view-invariant, resistant to visual noise, discriminable (any of the three okay for the point)
22. [4] Enter the term pop-out (P) or serial search (S) in the blanks below according to which best fits the statement.
- (a) A target that differs from all the distractors by only one primitive feature: **P**
 - (b) A target that differs from some distractors by one primitive feature and from other distractors by a different primitive feature: **S**
 - (c) The border between textures made up of forward slashes (e.g. /) on one side and backward slashes (e.g. \) on the other: **P**
 - (d) The border between textures made up of v shapes on one side and upside down v shapes on the other: **S**

23. [1] Circle the correct option (of the 3)

The ecological approach is concerned with the (**physiological structure/detailed psychophysical measurements/ function**) of vision.

24. [2] Describe the experiment with the toddlers in the swinging room including what they found and what it shows.

Toddlers were put in a room where the floor was stationary but the walls and ceiling could be moved. When the ceiling and walls were moved forwards the toddler fell forwards, presumably because they were assuming that the forward motion was due to them falling backwards and they compensated by moving forward. This shows that optic flow is important for maintaining balance.

25. [1] Fill in the blank

Neurons in area **MST** are selective to optic flow fields.

26. [3] Circle the correct option and fill in two blanks

In the experiment of judging the slope(slant) of a hill, subjects were more accurate when reporting (**haptically/visually/verbally**)[circle one]. This is important because it shows that there is some separation between vision for **perception** and vision for **action**.

27. [2]

(a) In addition to responding when a monkey does a particular action, when else do mirror neurons respond?
when the monkey sees someone else performing the same action

(b) Why are mirror neurons thought to be important?

**They are thought to be important in understanding the actions and intentions of others (theory of mind).
They might also be important to help imitate observed actions (either answer okay for the point)**

28. [0] Fill in the blanks

How many of the review sections did you attend last week on Tuesday and Wednesday _____?
Did you attend the Sunday review session _____? Did you attend the Monday evening review session _____? **More attendance is better!**

End of examination

Total pages: 9

Total marks: 70