

# Course Syllabus --- PSY 500 (VISUAL PERCEPTION)

Spring 2009

**Class Time** Mon. & Wed., 10:20-12:00 pm      **Room** 736 Poe

**Instructor** Donald H. Mershon, Ph.D.      **Office** 640-C Poe      **Phone** 919-515-1724  
**email** don\_mershon@ncsu.edu

This syllabus is also available at: <http://www4.ncsu.edu/~mershon/>

**Office Hours**      Immediately after class *and* by appointment. Sign-Up sheets are posted regularly on my office door for appointments at a variety of other times, *including* the remainder of most Monday, Wednesday and Friday afternoons.

If you need to reach me at other times, you may leave a message in my mailbox -- in 640 Poe Hall. (Please include phone numbers, so that I can get back to you as soon as possible.) However, if I don't come in, it will take a day or so to respond to notes. The preferred contact route, and the one that will usually get the quickest answer, is email (see address above). For messages of unusual urgency, my home phone is 919-872-8304.

**Text (CWE)**      Coren, S., Ward, L. M., & Enns, J. T. (2004). ISBN: 0-471-27255-8 *Sensation and Perception* (6th ed.). Hoboken, NJ: John Wiley. Approximately \$103 new through Amazon.com; used copies from same source start much lower. Please note edition.

## Supplementary Readings (SUPPL)

Most of the supplementary readings for the course will be made available through the electronic reserve collection at the DH Hill Library. Several other informational handouts and/or reprints will be supplied by the instructor. You are responsible for completing all such supplementary reading, unless specifically told that an item is simply being provided for your use as future reference material. NOTE that the supplementary reading list may be modified, if particularly useful or interesting items come to my attention after the start of the semester. Such additions or substitutions will be made only if there is reasonable time for adjustments to your reading schedule prior to an exam.

## Goals and Objectives of Course

PSY 500 is intended to be a fairly broad survey of the many visual processes that determine how we gain information about the three-dimensional world around us and about our own position in that world -- information that we must have for effective behavior (and even survival). Despite that general goal, PSY 500 includes many topics that are treated with some degree of depth. Such depth is provided, so that students can leave with an understanding that is more than merely a shallow collection of technical terms. It is hoped that students will achieve an appreciation for the wonder and complexity of their sensory systems (especially those involved with seeing). As part of their course participation, students will be exposed to a wide variety of perceptual experiences. It is hoped that the course will allow students to recognize relevant perceptual phenomena and/or "psychophysical" issues whenever and wherever they arise and to be able to connect such issues to their own interests and experiences, regardless of their specific fields of study. The instructor also hopes that the materials of the class will provide students with the necessary framework for accessing whatever technical or research information they need in the future.

## General Description of Lecture Coverage

- Section 1** --- photometry; physical & physiological optics; anatomy of the eye; ocular pathology; basic visual functions (acuity, adaptation, etc.) [8 lectures]
- Section 2** --- higher visual systems and processing; psychophysics (classical and modern); color vision [7+ lectures]
- Section 3** --- history of perceptual theories; form and pattern perception (including spatial frequency analysis and Gestalt contributions); important terminology & distinctions; factors in perceiving depth/distance; perceptual interactions, phenomenal geometry; movement perception [10-11 lectures]

## Prerequisites for PSY 500

The official prerequisite for Visual Perception is "graduate standing" (although PBS students and advanced undergraduates are certainly welcome). In fact, there are several kinds of important background that are not necessarily guaranteed by one's status as a graduate student.

Typically, all students should have successfully completed an introductory course in psychology and should be familiar with the biological bases of behavior (i.e., overall structures and basic functions of the central nervous system). No special prior knowledge about the senses or about perception itself is required. A general familiarity with biology, physics and simple mathematical concepts (e.g., log scales, algebra, trigonometry) can be very beneficial.

Due to the subtleties of language that exist in the course content, students with poor English skills – either listening or reading/writing – may find this course to be particularly challenging. Please consult with the instructor as early in the semester as possible, if you are concerned about the appropriateness of your background or skills.

## Evaluation

Evaluation of student performance in this course will be based upon the results of three exams. There will be an in-class exam for Section 1 and another in-class exam for Section 2. Section 3 will be covered on the Final Exam; the Final Exam will count slightly less than the two in-class exams combined, in keeping with the relative amount of material covered and the relative lengths of the exam periods.

Some consideration will be given to the extent of class participation and contribution, but this factor will only become critical if performance on the examinations is borderline. Grades will be the standard letter grades (A, B, C, D, F), adjusted in a few cases by +/- modifiers, to reflect somewhat-above-grade-level performance ( + ) or marginal performance ( - ).

NOTE: No term papers or outside projects are required. There are no provisions for "extra credit." Although roll will be called only for administrative reasons, YOU ARE RESPONSIBLE FOR EVERYTHING THAT OCCURS IN CLASS in the way of notes, demonstrations, announcements, etc. Please remember, however, that notes borrowed from others are usually a poor substitute for experiencing a demonstration for yourself. There is a strong relationship between regular attendance and the understanding needed for doing well on the exams.

### Format of Examinations

Examinations will be "closed book." Exams will emphasize lecture material, but there will be questions on reading material not explicitly covered in class. More details on the character of the exams (and some sample questions) will be provided prior to the first examination. Additional sample items will be distributed prior to Exam 2 and prior to the Final Exam.

Exams will include several different kinds of items, such as SHORT-ANSWER ITEMS (fill-in the blanks; matching terms on two lists; and what might be called "what would happen if....."). Other items will include longer IDENTIFICATIONS. Identification items will require definitions or descriptions of important terms, concepts, phenomena, etc. One-sentence responses will not be sufficient; greater detail, some context and more specificity will be required.

There may also be one or more SHORT-ESSAY QUESTIONS. Such items may require the presentation and/or discussion of broader factual or conceptual topics.

Finally, each exam will include some PROBLEMS, appropriate to the topics being covered. For example, one might be asked to follow ray(s) of light through various optical components like mirrors, filters, lenses, etc. One might be asked to locate an image or to indicate how measures of light change as a light source or a surface is altered. One might be asked to draw and/or label anatomical structures of the eye or upper visual systems. One might be asked to work some simple psychophysical problems and determine measures such as a threshold or the index of sensitivity. For the last section (2-D and 3-D form/space perception), one might be asked to consider a described scene, analyze the relevant spatial factors and make a prediction about how the situation would be perceived by an observer. (These are just examples; they are not necessarily an exhaustive list.)

Note: It is currently expected that traditional multiple-choice items will *not* be included. For the SHORT-ANSWER, IDENTIFICATIONS, and SHORT-ESSAY items, you will have some ability to select the items you wish to answer from a list of possible choices. PROBLEMS will be mandatory.

### Coverage of Examinations

**Exam #1** covers material from the lectures and readings through the visual anatomy/function/disorders of the eye, including its musculature and motor control systems. **Exam #2** covers material on the anatomy/function of the upper visual systems, psychophysical methods and color vision. Exams #1 and #2 each require approximately one full class period to complete.

The **Final Exam** covers all material from the lectures and readings of Section 3; it requires approximately 3 hours to complete. The Final Exam is not intentionally comprehensive; explicit questions are typically limited to material from Section 3. (Of course, a full response to certain items on the Final could require reference to earlier information.) The main exception would be a possible spelling test, if appropriate care is not shown during earlier exams. (Thus, please be careful with spelling of words such as: "accommodation," "perceived," "ophthalmology," etc.)

**Dates & Scheduling**

(firm, *unless*  
there is a class  
cancellation)

Jan. 7 (Wed.)..... first day of class for Section 1  
 Jan. 19 (Mon.)..... Martin Luthor King HOLIDAY  
 Feb. 4 (Wed.)..... last class for Section 1  
**Feb. 9 (Mon.)..... EXAM #1**  
 Mar. 2 and 4 ..... UNIVERSITY SPRING BREAK  
 Mar. 16 (Mon.).....last class for Section 2; start Section 3?  
**Mar. 18 (Wed.).....EXAM #2**  
 Apr. 22 (Wed.).....last class for Section 3  
**May 1 (Friday)..... FINAL EXAM, 8:00-11:00 am (Poe 736)**

**Note:** The material for PSY 500 is quite structured. If the university must close for a "snow day," or if the instructor becomes ill and must cancel class, we *will* need to make suitable arrangements for one or more "make-up" classes. Such make-up classes will likely be scheduled for the same class time on a Friday, because that time should usually be free for everyone in the class. If a make-up class is necessary, then it will be announced as much ahead of time as possible and the above schedule of dates will be "pushed" forward as needed. Thus, Exam dates *could* change for such "emergency" situations (e.g., the university closes for snow on the day of the exam or so soon beforehand that a make-up class cannot be scheduled in time to stay with the existing schedule). Changes in schedule will be announced or confirmed by email, if at all possible.

Students are all expected to take exams at the same time. Those who must individually reschedule an exam for *any* reason (e. g., student illness, family emergency or other *unforeseeable* events) should contact the instructor *as soon as possible*. Make-up Exams should occur **BEFORE** exams are returned to the class

**IMPORTANT:** *Regardless of when an exam is taken, it will be assumed that a strict Honor Code applies. During an examination, no one should use any notes or books. No one should seek information from or provide information to another. If, at any other time, you are talking with someone who has not yet taken a particular exam or if you yourself still need to take it, you should conscientiously avoid discussing the examination in any way. Failure to observe this expectation will result in disciplinary action. See full policy at:*

*[http://www.ncsu.edu/policies/student\\_services/student\\_discipline/POL11.35.1.php](http://www.ncsu.edu/policies/student_services/student_discipline/POL11.35.1.php)  
or visit the web site for the Office of Student Conduct at:  
[http://www.ncsu.edu/student\\_affairs/osc/](http://www.ncsu.edu/student_affairs/osc/)*

**Attendance:** Students are expected to attend every class. Absences disrupt the continuity that is vital to understanding. If you must miss class, you would be wise to have a pre-arranged "buddy" who can at least provide you with notes.

NCSU does not discriminate on the basis of race, color, national origin, religion, sex, age, or disability. With respect to disabilities, Section 504 of the Rehabilitation Act of 1973 provides that: "No otherwise qualified handicapped individual in the United States shall, solely by reason of his or her handicap be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance." NCSU abides by these regulations. The instructor for PSY 500 will make "reasonable adjustments" to ensure that students with hearing, visual, motor, or learning disabilities can participate as fully as possible and that the academic requirements of the course are administered in a non-discriminatory manner. For further information and/or assistance in arranging for special needs, please contact the Disability Services Office, located in Suite 1900 of the Student Health Center, 2815 Cates Avenue (voice phone: 515-7653; TTY: 515-8830) or go to: [http://www.ncsu.edu/equal\\_op/dss/](http://www.ncsu.edu/equal_op/dss/)

And some additional introductory information.....

(D. H. Mershon)

### **The Language Of Perception**

One of the difficulties in studying perception, as in studying many of the other areas of psychology, is learning to understand and use the specialized terminology correctly. This learning process is often complicated by the *seeming* familiarity of the words used. The common usage of a term and its technical meaning, however, may not be the same. Hence, it is important to be clear in one's choice of words to describe psychological phenomena and concepts.

A particular problem in the study of perception concerns the absolute necessity of distinguishing between physical variables (dimensions of the real environment such as light intensity, wavelength, physical distance, etc.) and the corresponding perceptual variables (dimensions of experience such as brightness, color, apparent distance, etc.). Sometimes more than two "levels" of conceptualization are required, but there are always at least two --- the physical and the perceptual. Physical variables are what you can directly measure or manipulate with the appropriate equipment; perceptual variables involve your experiences of the events around you. Perceptual experiences are based upon the activity of your various sensory systems (vision, hearing, etc.) and are often correlated with the changes in the physical world. They are, nevertheless, conceptually distinct from those physical events. Before one can talk about perception in a meaningful way, it is necessary to establish a clear distinction between *physical* and *perceptual* in one's thinking and one's vocabulary.

The preceding discussion should not be taken to indicate that uniformly correct usage is always easy. Sometimes even people well-practiced in the language of perception use a word in its common (non-discriminating) manner, rather than with technical precision. Sometimes the English language itself simply does not provide enough convenient alternatives to allow the exclusive use of separate terms for physical and perceptual variables. For example, the word "color" is often used to indicate both the wavelength of a light (a physical variable) and the appearance of that light (a perceptual variable). These limitations, however, in no way diminish the importance of striving to make clear distinctions in any context where a failure to do so can lead to ambiguity.

### **Some URLs Of Possible Interest**

As one might expect, there are now many thousands of web sites that are dedicated to perceptual phenomena or that provide related information on the structure, function and pathology of the underlying sensory and brain systems. Many of these include an excellent variety of demonstrations on widely divergent topics. To make a sampling of such sites easily accessible, you will find links to many locations on the *NCSU Perception Page*. URL is: <http://www4.ncsu.edu/~mershon/>

The very mass of frequently-changing data, however, makes full monitoring of every site a virtual impossibility. While I think you'll discover many interesting things among the linked sites, I can **not** vouch for the full accuracy of each and every piece of information you may find. Please use your own background, what you've learned from PSY 500, and a healthy sense of skepticism, in evaluating what you read.

The availability of these sites has been verified as of January 2009. Please let me know if you find that any of them has disappeared. (It's good to check a site on a couple of different days, in case it is down on a temporary basis.) Also, please pass along any new sites you discover, so that they can be added to the list for future semesters. Thanks.



USE OF LOGARITHMIC SCALES:

Sensory systems are often capable of handling a very wide range of physical intensities. In order to describe the operation of such systems in an understandable and convenient manner, logarithmic scales are frequently employed in place of linear ones. Although other forms of logarithmic scales exist, the following discussion will consider only logarithms to the base 10, since these are in most common use.

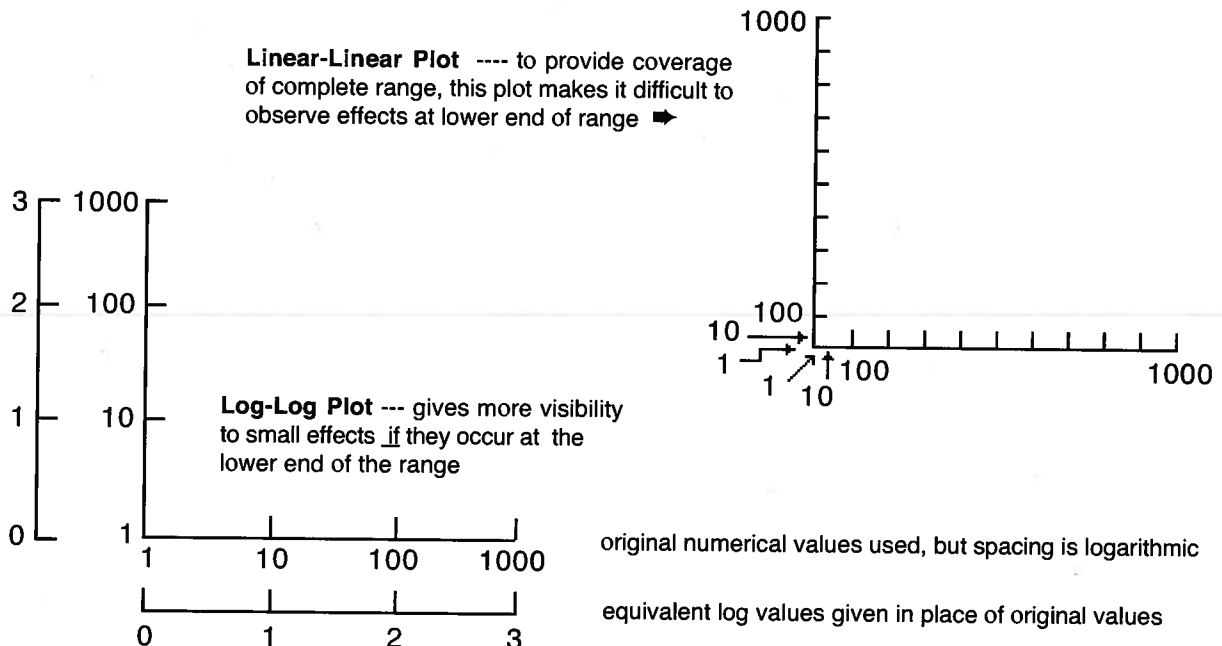
Put simply in words, a logarithm to the base 10 of any number N is that exponent to which one must raise 10, in order to produce the number. If we use x to represent the value of the logarithm, then the following relationships are true:

$\text{Log}_{10} N = x$	<u>N</u>	<u>x</u>	$10^{-3} = \frac{1}{10^3}$
	.001	-3	
$10^x = N$	.01	-2	
	.1	-1	Any number to the
	1.	0	0th power = 1
	10.	1	
	100.	2	
	1000.	3	

Note that the number N increases by a factor of 10-times for each increase of 1 log step. Thus,

$10^1 = 10$        $10^2 = 100$        $10^3 = 1000$       and so on.

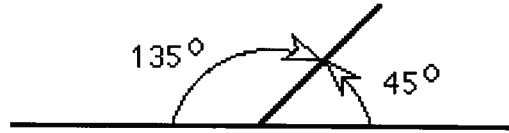
The graphs shown below demonstrate some of the differences between a linear-linear plot and a log-log plot (the double use of the terms "linear" and "log" refers to the fact that both axes involve the same type of scale).





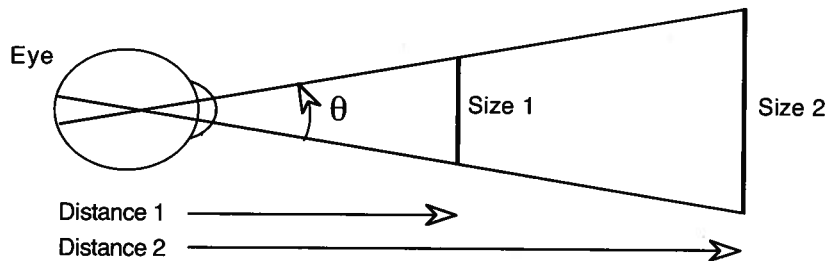
ANGULAR MEASUREMENT:

The use of angular measures is frequently required to describe visual stimuli. This use may be as simple as describing the angles of a square as being right-angles or indicating the orientation of a line, with respect to the horizontal:



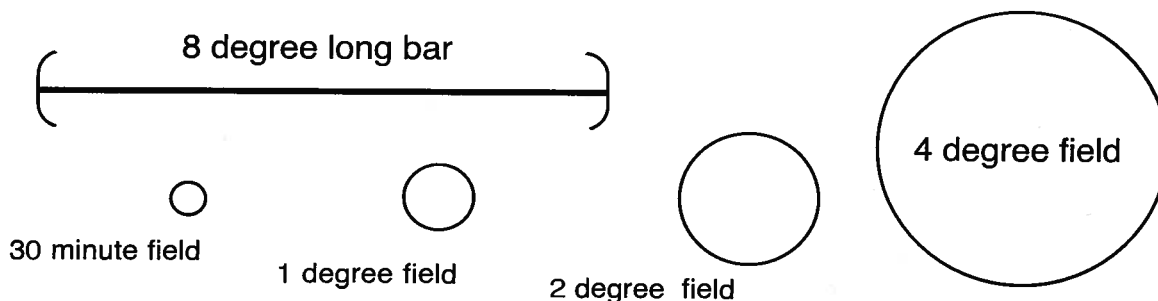
In using angular measurements, 1 degree is said to contain 60 minutes and each minute contains 60 seconds. Another measure of angular extent is the radian, where 1 rad = 57.29578 degrees.

One can, however, also use angular measurements in a less common manner to describe the size of visual stimuli. Consider the diagram below that shows an eye, two alternative objects at which the eye might look, and some "lines-of-sight" from the eye to the ends of the objects. For visual perception, the crucial stimulus is usually the pattern of light as it falls on the eye. One could describe that pattern by indicating both the size and distance of the object of interest. In many cases, however, it is more convenient to give the object's "angular size" (as symbolized by the Greek letter theta ---  $\theta$  ). This measurement is called the *Visual Angle* and is expressed in values such as degrees, minutes and/or seconds (see above). Any linear dimension of a visual stimulus (height, width, etc.) may be expressed in these angular terms. Note below that size 1 at distance 1 and size 2 at distance 2 produce equal  $\theta$ .



For situations in which  $S$  (size) is small, relative to  $D$  (distance), then:  $\theta_{deg} = \text{arc tan } \frac{S}{D}$

For some everyday comparisons, one can remember that, at an average arm's length of 57 cm, the image of your hand is about 10 deg ( $10^\circ$ ) wide and that a quarter coin "subtends" a visual angle of just over 2 deg ( $2^\circ$ ). The same coin viewed from 82.5 m subtends 1 min. and viewed from 4950 m (just over 3 miles) subtends 1 sec. The scale shown below will be *approximately* correct when this paper is held an arm's length away from your eyes:



## READING ASSIGNMENTS for Visual Perception (PSY 500)

Spring 2009

Items are listed in the *approximate* order of lecture topics; the order is not precise, since the readings and lectures emphasize different topics and have a different organization. You may jump around if you find it helpful.

CWE = main text [Coren, Ward & Enns, Sensation and Perception, 6th edition (2004)]

SUPPL = supplementary readings (as identified below)

### Section 1 (Vision) ---

#### Syllabus

CWE **Preface & Chapter 1** (Introduction)

SUPPL Rainwater, C. S., Perlman, R., Zim, H. S., & Webster, V. R. (1971?). **Light and Color**. New York: Golden Press. Pp. 29-75.

CWE **Chapter 3** (The visual system), pp. 43-63.

SUPPL Kolb, H. (2003). How the retina works. *American Scientist*, 91, 28-35

CWE **Chapter 4** (Brightness and ....), pp. 80-92.

SUPPL Dawkins, R. (1996). The forty-fold path to enlightenment. Ch. 5 in **Climbing Mount Improbable**. New York: W. W. Norton. Pp. 138-197.

CWE **Chapter 11** (Time), pp. 330-355.

SUPPL Goldstein, E. B. (2002). **Sensation and Perception**, 6th ed. Pacific Grove, CA: Wadsworth. (Ch. 16, Clinical aspects of vision and hearing, pp. 545-564; stop after vision.)

SUPPL Catania, A. C. (2007). Strange visions: Haloes, dust storms, and blood on the walls. *Skeptical Inquirer*, 31, 47-50.

SUPPL Francis, E. L., Bai-Chuan, J., Owens, D. A., & Tyrrell, R. A. (2003). Accommodation and vergence require effort-to-see. *Optometry and Vision Science*, 80, 467-473.

SUPPL Arumi, P., Chauhan, K., & Charman, W. N. (1997). Accommodation and acuity under night-driving illumination levels. *Ophthalmic and Physiological Optics*, 17, 291-299.

#### OPTIONAL READINGS:

- Riggs, L. A. (1964). Light as a stimulus for vision. Ch. 1 in C. H. Graham (Ed.), **Vision and Visual Perception**, pp. 1-38. New York, NY: John Wiley & Sons.
- Owens, D. A. (1984). The resting state of the eyes. *American Scientist*, 72, 378-387.
- Henderson, J. M., & Hollingworth, A. (1999). The role of fixation position in detecting scene changes across saccades. *Psychological Science*, 10, 438-443.

----- Exam #1 -----

### Section 2 (Vision) ---

CWE **Chapter 3** (The visual system), pp. 63-79.

CWE **Chapter 13** (Attention)

CWE **Chapter 14** (Consciousness)

SUPPL Biederman, I., & Vessel, E. A. (2006). Perceptual pleasure and the brain. *American Scientist*, 94, 249-255.

SUPPL Olshausen, B. A., & Field, D. J. (2000). Vision and the coding of natural images. *American Scientist*, 88, 238-245.

CWE **Chapter 2** (Measuring perception)

#### Handouts on Psychophysics (2)

SUPPL Kruskal, J. B., & Wish, M. (1978). **Multidimensional Scaling**. Beverly Hills, CA: Sage Publications. (First part of Ch. 1, Basic concepts of multidimensional scaling, pp. 7-15.)

CWE **Chapter 4** (.....and color), pp. 93-115.)

CWE **Chapter 10** (Perceptual constancies), pp. 307-312 (on lightness/color constancy).

SUPPL Levine, M. W. (2000). **Fundamentals of Sensation and Perception**, 3rd ed. New York: Oxford University Press. (Brief selections from Ch. 14, Color vision, pp. 305-310 & 317-319.)

SUPPL Hansen, T., Olkkonen, M., Walter, S., & Gegenfurtner, K. R. (2006). Memory modulates color appearance. *Nature Neuroscience*.

#### Handout on Color Blindness

SUPPL Birch, J. (1993). **Diagnosis of Defective Colour Vision**. New York: Oxford. (Ch. 10, Filter aids for colour deficient people, pp. 168-173; and Ch. 11, The occupational consequences of defective colour vision, pp. 174-184.)

**OPTIONAL READINGS:**

- Livingstone, M., & Hubel, D. (1988). Segregation of form, color, movement, and depth: Anatomy, physiology, and perception. *Science*, 240, 740-749.
- Mendelson, J. R., & Wells, E. F. (2002). Age-related changes in the visual cortex. *Vision Research*, 42, 695-703.

----- **Exam #2** -----

**Section 3** (Visual Perception)

- SUPPL Wagner, M., & Owens, D. A. (1992). Introduction: Modern psychology and early functionalism. In D. A. Owens & M. Wagner (Eds.), **Progress in Modern Psychology. The Legacy of American Functionalism**. Westport, CT: Praeger. (Read pp. 3-14.)
- CWE **Chapter 8** (Patterns and Edges)
- CWE **Chapter 9** (Space)
- CWE **Chapter 10** (Object and Scene Perception; pp. 307-312 already read)
- SUPPL New, J., Cosmides, L., & Tooby, J. (2007). Category-specific attention for animals reflects ancestral priorities, not expertise. *Proceedings of the National Academy of Sciences USA*. October 16; 104(42): 16598-16603. Published online 2007 October 1. doi: 10.1073/pnas.0703913104. Retrieved January 21, 2009, from <http://www.pubmedcentral.nih.gov/>
- SUPPL Stevens, S. S. (1974). S.S. Stevens. In G. Lindzey (Ed.), **A History of Psychology in Autobiography, v. 6**. Englewood Cliffs, NJ: Prentice-Hall. pp. 393-420.
- SUPPL Pratkanis, A. R. (1992). The cargo-cult science of subliminal persuasion. *Skeptical Inquirer*, 16 (No. 3, Spring), 260-272.
- SUPPL Blake, R. (1998). What can be "perceived" in the absence of visual awareness? *Current Directions in Psychological Science*, 6, 157-162.
- SUPPL Martinez-Conde, S., & Macknik, S. L. (2008). Magic and the brain. *Scientific American*, 299 (No. 6, Dec.), 72-79.
- SUPPL Levine, M. W. (2000). **Fundamentals of Sensation and Perception**, 3rd ed. NY: Oxford Univ. Press. (Ch. 9, Spatial frequency representation, pp. 155-183.)
- SUPPL Leibowitz, H. W., Owens, D. A., & Tyrrell, R. A. (1998). The assured clear distance ahead rule: Implications for nighttime traffic safety and the law. *Accident Analysis and Prevention*, 30, 93-99.
- SUPPL Bruce, V., Green, P. R., & Georgeson, M. A. (1996). **Visual Perception: Physiology, Psychology and Ecology**, 3rd ed. East Sussex, GB: Psychology Press. (Ch. 11, Introduction to the ecological approach to visual perception, pp. 255-266.)
- SUPPL Franz, V. H., Gegenfurtner, K. R., Bühlhoff, H. H., & Fahle, M. (2000). Grasping visual illusions: No evidence for a dissociation between perception and action. *Psychological Science*, 11, 20-25.
- SUPPL Gogel, W. C., & Mertz, David L. (1989). The contribution of heuristic processes to the moon illusion. In M. Hershenson (Ed.), **The Moon Illusion** Hillsdale, NJ: Erlbaum. Pp. 235-258.
- SUPPL Foley, J., Loomis, J., & Mershon, D. (2006). Walter Gogel: In memoriam.
- CWE **Chapter 12** (Motion)
- SUPPL Young, K. R., Mershon, D. H., & Hicks, L. J. (2002). The Far-Anchor Effect: Errors in the perception of motion and implications for aviation safety. *Human Factors*, 44, 133-143
- CWE **Chapter 15** (Development) – not responsible for details of non-visual systems
- CWE **Chapter 16** (Learning and Experience) – not responsible for details of non-visual systems

**OPTIONAL READINGS:**

- Rock, I. & Palmer, S. (1990). The legacy of Gestalt psychology. *Scientific American*, 263 (No. 6, Dec.), 84-90.
- Lemley, B. (2000). Isn't she lovely?. *Discover*, 21, (No. 2, February), 42-49.
- Gogel, W. C. (1990). A theory of phenomenal geometry and its applications. *Perception & Psychophysics*, 48, 105-123. Recommended only for advanced students.
- Suzuki, S, & Peterson, M. (2000). Multiplicative effects of intention on the perception of bistable apparent motion. *Psychological Science*, 11, 202-209.
- Norman, J. (2001). Ecological psychology and the two visual systems: Not to worry! *Ecological Psychology*, 13, 135-145.

----- **Final Exam** -----