

COURSE OUTLINE

The specifics of this sequence will be modified to fit especially interesting directions as we proceed. For example, as I'm making up the syllabus (below) for this semester, it's clear that we will be spending Jan 29 and most, if not all of Feb. 5 on readings related to the 'Two Visual Systems' story.

1. Jan. 22 Organization and Introduction to Space Perception
2. Jan. 29 Two Visual Systems: What/Where and/or Perception/Action?
3. Feb. 5 More on the Where modality
4. Feb. 12 Perceptual Consequences of Visual/Vestibular Interactions
5. Feb. 19 Eye Position Information and Spatial Localization. I. A Spatial Constancy
6. Feb. 26 Eye Position Information and Spatial Localization. II. Inflow
7. Mar. 5 Perception of Elevation: Egocentric Space Perception: A Second and Different Constancy
8. Mar. 12 Basic Visual Psychophysics, Modeling, the Constant Response & Invariants
Mar. 19: Spring Holiday
9. Mar. 26 Perception of Slant
10. Apr. 2 Perception of the Vertical
11. Apr. 9 Binocular Vision and Stereovision
12. Apr. 16 A Computational Model for the Perception of Depth
13. Apr. 23 Perception of Motion and Control of Motor Behavior: Relations to Perception
14. Apr. 30 Auditory Localization

Some References Useful for Basic Background

1. Basic Visual Information:

Wolfe, J. M., Kluender, K R. Levi D. M. Sensation and Perception. (2nd ed. 2008, 1st ed. 2005)

Goldstein, B. Sensation and Perception (either 7th edition, 2007 or earlier), or any other sensation and/or perception text. Authors of some such texts: R. Sekuler & R. Blake; M. Levine; B. Wandell; R V. Bruce, P. Green & M. Georgeson.

2. Useful Additional References on Vision:

Graham, C.H. Vision and Visual Perception, 1965

Cornsweet, T. Visual Perception, 1970

Rodieck, R.W. The First Steps in Seeing, 1998

Zeki, S., A Vision of the Brain, 1993

Hubel, D. Eye, Brain, and Vision, 1988, 1995

Readings from Scientific American: Perception: Mechanisms and Models (R. Held & W. Richards, [eds]), 1971.

Readings from Scientific American: Recent Progress in Perception (R. Held & W. Richards), 1964, 1975.

Dowling, J. E. The Retina, 1987

3. Any elementary physics book (Light, Optics, etc.).

4. Some Additional Books to be used during the Semester

1. Nijhawan, R. & Khurana, B. (eds.) Problems of Space and Time in Perception and Action, 2010, Cambridge University Press.

2. Marr, D. Vision. 1982

3. Howard, I. Human Visual Orientation, 1982

4. Howard, I. and Templeton, Human Spatial Orientation, 1966

5. Hein, A. & Jeannerod, M. Spatially Oriented Behavior, 1983

6. Barlow, H. and Mollen, J. [eds], The Senses, 1982

7. Hubel, D. & Wiesel, T. Brain and Visual Perception. 2005, Oxford

8. Cohen, B., Tomko, D. and Guedry, F. [eds.], Symposium on Sensing and Controlling Motion: Vestibular and Sensorimotor Function, Annals of the New York Academy of Sciences. **656**, 1992.

Seminar in Space Perception: W3250y

Prof. Leonard Matin

Dept. of Psychology

9. Howard, I. & Rogers, B. Seeing in Depth, Vol 1, Vol. 2, 2002

Sensation & Perception G4230y

Spring, 2013, 6:10-8:00 pm, Tuesday

Room 405, Schermerhorn Hall

**THE FOLLOWING PAGES PROVIDE A PRELIMINARY LIST
OF ASSIGNED READINGS FOR DISCUSSION DURING THE FIRST 7 MEETINGS**

Readings For Class Meetings on Jan 22, Jan 29, and Feb. 5, 2013

TOPIC: TWO VISUAL SYSTEMS

Books with Initial Readings:

1. Milner, A.D., and Goodale, M.A. The Visual Brain in Action. 1995
2. Gazzaniga, M. (ed). The Cognitive Neurosciences. 1995

Readings

Two Visual Systems

- **1.** Milner & Goodale (book 1). (ch. 1, pp. 1-24)

Basis in Neuroanatomy and “Heredity” for Spatial Localization and Orientation

2. Sperry, The Eye and the Brain (5 pages)
3. Ingle Two Visual Systems in the frog. **Science**, 1973, **14**, 1053-55. (3pages)

Human Pathology

4. Goodale, et al., A neurological dissociation between perceiving objects and grasping them. **Nature**, 1991, 349, 154-156 (3 pages; folder)

Normal Human Two Systems (Dissociated Perception/Action)

5. Aglioti, S., Goodale, M., & DeSouza, J., **Curr. Biol.**, 1995, 5, 679-85.
6. Graziano & Gross, Mapping space with neurons. **Curr. Dir. in Psychol. Sci.**, 1994, 3, 164-167 (4 pages)
7. Li, W. & Matin, L. Two Wrongs Make a Right.... **Vision Research**, 2005, 45, 533-550. **FOR CLASS: Only Look at:** Footnotes 1 & 2 (pp. (534-535) on the recent history of the Two Visual Systems Concept

More Readings

1. Goodale, Jakobson, Milner, Perrett, Benson, and Hietanen, The nature and limits of orientation and pattern processing supporting visuomotor control in a visual form agnostic. **J. Cogn. Neurosci.**, 1994, 6, 46-56
2. Graziano, M. and Gross, C. (book 2), Ch. 67, pp. 1021-1034.
3. Blakemore, C. & Cooper, G. Development of the Brain depends on the visual environment. **Nature**, 1970, 228, 477-478.

Some Basic Orienting Questions

TWO VISUAL SYSTEMS:

1. What is the “two visual systems concept?”
2. What is the neuroanatomy that underlies the “two visual systems concept”
3. What is the behavioral evidence from animals that underlies the view that the two systems subserve “what” and “where”, respectively? (**ONLY** sec 1.3.3, pp. 20-24 in Milner & Goodale, chapter.).
4. What is the behavioral evidence from humans that underlies the view that two systems subserve “perception” and “action”, respectively? **Readings 4 & 5 & chapt. in 1**
5. Before getting into the details, the person presenting the Ingle article should tell us what the main point is. Reading 2 & chapt.

SPERRY AND JUMPING FROGS

1. What are the two kinds of experimental changes that were made on the frog's visual system that led to changes in the frog's behavior (or to no changes)?
2. What are the significant things that Sperry's experiments tell us? What is the biggest surprise?

FURTHER INTO THE DORSAL SYSTEM

1. Coordinate systems: distinguish retinotopic, head-centered, arm-centered. (big-toe-centered?)
 2. How would an arm-centered neural network with visual input from V1 be constructed (Black box style)?
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The list below is to provide the next batch of material, nominally for the Feb 12 meeting.

TOPIC: VISUAL-VESTIBULAR INTERACTIONS

Note that I've separated the list below into four segments. The first reading (Benson) provides some basics of the vestibular system; it contains a good description with more detail than we're going to need here.

The articles with * will be subjects of seminars. The other readings are very closely related to the asterisked items but will not get assigned as seminar topics in themselves -- they will provide a great deal and are well worth reading. (For Benson, I'm going to give a very short bit (maybe one paragraph's worth) on some of the elements of functional anatomy. The section noted on cross-coupling will be a short seminar topic after the other three).

Some Perceptual Consequences of Visuo-Vestibular Interactions

1. Benson, A. . Ch. 16, The vestibular sensory system, pp. 333-368.
In: Barlow and Mollon (eds.) **The Senses**. (book 5)
*The example of the effects of cross-coupled stimulation on pages 362-365 described in Benson is well worth working through.
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- *2. Cohen, M. Elevator illusion: Influences of otolith organ activity and neck proprioception. **Perc. & Psychophys.**, 1973, 14, 401-406.
3. Cohen, M. Perception and action in altered gravity. **Ann. NY Acad. Sci.**, 1992, 656, 354-363.
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- *4. Dichgans, J. and Brandt, T. The psychophysics of visually induced perception of self-motion and tilt. Schmitt, F.O & Worden, F. **The Neurosciences.**, 1974. ch. 12, pp. 123-130.
5. Brandt, J., Dichgans, J. and Koenig, E. Differential effects of central versus peripheral vision on go-centric and exocentric motion. **Exp. Brain. Res.**, 16, 476-491.
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- *6. Lackner, J. Orientation and movement in unusual environments. **Psychol Sci.**, 1993, 4, 134-142.
7. Lackner, J. & Graybiel, A. Some influences of touch and pressure cues on human spatial orientation. **Aviation, Space, and Environmental Medicine**. 1978, 798-804.
8. Lackner, J and Graybiel, A. Postural illusions experienced during z-axis recumbent rotation and the dependence upon somatosensory stimulation of the body surface. **Aviation, Space, and Environmental Medicine**, 1978, 484-488.

Note

1. Simplistics of the vestibular organ:
 - (a) The functional differences between the semicircular canals and the otolith organs and the basis for these in structure. The elementary physics involved in each sense organ determines the different functions.
 - (b) How well does the following hold up?
Elevator illusion --> otoliths
Illusion of self-motion --> semicircular canals

**TOPIC: INFLUENCES ON SPACE PERCEPTION FROM VISUAL AND
EXTRARETINAL SOURCES**

We're going to discuss three readings for this topic: All 3 support the inflow theory

1. Skavenski, A. Inflow as a source of extraretinal eye position information. **Vision Research**, 1972, 12, pp. 221-229.
2. Hein, A., Vital-Durand, F., Salinger, W., and Diamond, R. Eye movements initiate visual-motor development in the cat. **Science**, 204, 1321-1322.
3. Hein and Diamond. Contribution of Eye Movement to the Representation of Space. Ch. 7, 1982. It's in a book edited by Hein & Jeannerod.

Some Orienting Matters and Questions

In order for the discussion to be fruitful we're going to need a bit of background. I'm going to try to provide some background in class for this. Some useful material on these matters is:

Matin, L. Visual Localization and Eye Movements. Ch. 20. in Handbook of Perception and Human Performance. Vol. 1, Sensory Processes and Perception. Eds: Boff, Kaufman, and Thomas. **PARTICULARLY PAGES: Page 20-2 through Page 20-7.** (Brief descriptions of the three readings are also in this chapter.)

Regarding reading 1.

1. Why might one hope to separate inflow and outflow theories -- and thus determine the validity of one or the other -- by reducing the normal level of responsiveness of extraocular muscle? What then can one infer regarding the two theories from the bare fact that the spatial mislocalizations that occur in darkness are systematically related to the position of the eye in the orbit?

This is to introduce a single article for reading now on egocentric space perception (the primary reading; we won't have the other two presented, but they are on courseworks). We'll do some other things on egocentric space perception shortly.

Egocentric Space Perception

I've selected a classic article that really opened the modern era for egocentric space perception. It is one of a series of four articles that were awarded "best article in the journal for that year", and received other awards later. The number of references to it is huge. It continues to be referred to as a centerpiece for numerous research programs. Surprisingly, (as in the *Scientific American* article in 1959) the work also opened an entire field in "Personality" concerned with "Cognitive Styles" that was one the most significant fields during the 50s to the 70s.

Witkin's work was well-supported by ONR, and there is an interesting historical background to that. We had invaded the above-ground and below-ground three-dimensional world with airplanes and submarines and some peculiar things happen to humans when we go there -- we are not adapted to either above or below ground,. In the twenties, pilots flying solo or with a second person in a second cockpit, would emerge from a cloud bank upside down and not be aware of it, on some occasions, until it was too late when they hit the ground. So, a great deal of concern was obviously raised.

There was an interesting intellectual background to Witkin's work also. There was controversy about whether vision or our sensing the direction of gravity was more significant in our perception of spatial orientation. In 1937, Gibson and Mowrer published an article that took the strong position that sensing the direction of gravity was more significant. However, in agreement with Wertheimer's earlier work with a tilting mirror (1912), Witkin's work made it clear that they were wrong, and that vision was the dominant sense modality; without attempting to minimize the role gravity, this is the picture as it has remained ever since: Here "Vision" refers specifically to the influence on the "frame of reference for orientation". This early position of Gibson on this matter is historically particularly interesting since he has become well-known for a phenomenological approach to perception, emphasizing vision to the point of referring to some aspect of our egocentric space perception as "Visual Kinesthesia".

Primary Reading

1. **Asch, S.E. and Witkin, H.A. (1948).** Studies in space orientation II. Perception of the upright with displaced visual fields and the body tilted. **J. Exp. Psychol.**, **38**, 455-477.

Supplementary

2. **Witkin, H.A. and Asch, S.E. (1948).** Studies in space orientation IV. Further experiments on perception of the upright with displaced visual fields. **J. Exp. Psychol.**, **38**, 762-782.
3. **H. A. Witkin (Mar., 1959).** Perception of the upright. *Scientific American*, 49-56.

TOPIC: EGOCENTRIC SPACE PERCEPTION II: ELEVATION

Primary Reading

1. **Matin, L., Picoult, E., Stevens, J. K., Edwards, M. W. Jr., Young, D., & MacArthur, R. (1982).** Oculoparalytic illusion: visual-field dependent mislocalizations by humans partially paralyzed with curare. *Science*, **216**, 198-201.
2. **Matin, L., & Fox, C. R. (1989).** Visually perceived eye level and perceived elevation of objects: linearly additive influences from visual field pitch and from gravity. *Vision Research*, **29**, 315-324.

These two articles will take us into work in my lab. We'll visit the lab and see some surprising perceptual phenomena. that were first described in the second reading. How these phenomena in normal human observers relate to phenomena measured with experimentally paralyzed observers (first reading) will be a subject for discussion. That discussion will also tie together some of what we had dealt with in our earlier treatment relating eye movements and spatial localization.