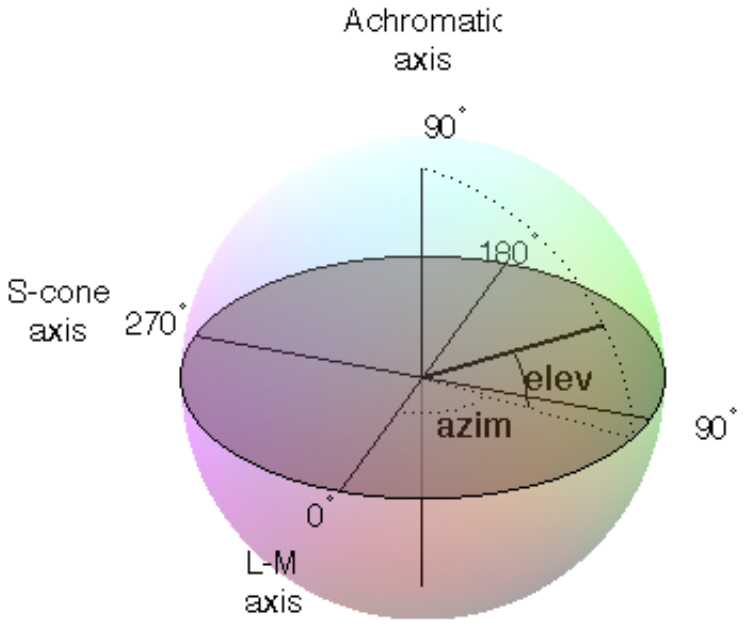
Psychology of Perception

Psychology 4165, Spring 2014

Laboratory 3:

Equiluminance Motion Detection



DKL Color Space

Lab 3: Equiluminance Motion

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11:00–11:50 MWF

Lab 3: Equiluminance Motion

Introduction

Color is a psychological experience created by three perceptual mechanisms: red-green and yellow-blue chromatic opponent processes, and a luminance process. Our ability to detect motion and see fine spatial detail comes largely from the information in the luminance channel (Ramachandran & Gregory, 1978). So if we create red target against a green background (for example) our ability to process fine detail and motion is determined by the luminance contrast, not the color contrast between target and background. Furthermore, if we make the two colors equal in luminance (so-called equiluminant or isoluminant stimuli), our ability to detect motion and fine detail should be hindered.

In this lab exercise you will measure your ability to detect motion in a field of random dots that are biased to move slightly to the left or two the right. These random dot kinematograms (RDK) are widely used in perceptual research (Cavanagh, Boeglin, & Favreau, 1985; Scase, Braddick, & Raymond, 1996), and are easy to generate in PsychoPy.

Methods

Procedure: There are two steps for measuring your motion thresholds for equiluminant and non-equiluminant stimuli:

1. Measure the luminance values of red and green that will make them equal. You will use the PsychoPy program **equiluminance.psyexp** found in the Lab_3 Tools in the equiluminance exp folder to make these measurements. Move the mouse back and forth so that the border between the red and green patches is minimally distinct and the two colors seem equal in luminance. Play around with the settings until you are satisfied. Then click the mouse to record the value and run another trial. After 10 trials, the mean of your ten values will be displayed. Record this value in Appendix I.
2. Now run the **motion_coherence.psyexp** script and make judgments about whether you perceive motion to the left ('left' key) or to the right ('right' key). When you first start the program, enter your initials and your equiluminance value that you just measured into the fields of the dialog box. On each trial of the experiment you will see a square field of random dots presented for four seconds. Some of the dots are moving in random directions. A percentage of the dots, however, are all moving in the same direction: either to the left or to the right. The proportion of dots moving coherently in on direction is called the coherence. This proportion is varied from trial to trial. The values of coherence and the direction of the motion are determined by the Excel conditions file named conditions_coherence.xlsx. Press the "left" or "right" key to indicate which direction you think the coherent dots were drifting.
3. There are two blocks of trials, presented in a randomly chosen order. In one block, the red dots seen against the green background have a high luminance contrast. It is labeled 30 in the Derrington-Krauskopf-Lennie

(DKL) color space (Derrington, Krauskopf, & Lennie, 1984; MacLeod & Boynton, 1979). This color space is (like other color spaces) three dimensional and uses spherical coordinates. One dimension is call elevation and it is an angle tilt above the isoluminant plane in the sphere. The second dimension is azimuth, which corresponds to hue in a color circle. The third dimension is contrast, which corresponds to height above and below the center of the sphere at a right angle to the isoluminant plane along the achromatic axis. The DKL system is built into PsychoPy, along with RGB and HSV color spaces. The other block of trials is labeled 0 elevation and corresponds to a red and green that are isoluminant.

Individual Data Analysis: The trial by trial data from the experiment are found in the data folder as a csv file. You will use R to compute the number of 'right' responses to the different motion speeds set in the conditions_coherence.xlsx file. The R-script for transforming the raw data into response frequencies and into response probabilities, for fitting an s-shaped psychometric function to the data, and for plotting your results, is in the file lab3_glm.R found in the Data Analysis folder. The analysis of these data is very similar to the one you made on the orientation discrimination data in Lab 1. The coherence needed to discriminate left from right is the coherence needed to achieve 16% and 84% "right" response performance levels. The script reports these values in jnd.00 and jnd.30 for the two luminance conditions, 0 deg elevation and 30 deg elevation. We expect that jnd.30 will be smaller than jnd.00 if equiluminance stimuli are not processed by the motion perception channels in the visual system. Compare your results with the motion experiment described on page 234 of our text book (Yantis, 2014). Are they similar? Are they different?

Group Data Analysis: Record your results in the table on page 5 and then transfer them to the group data sheet. We will assemble all the data and make them available next week for group data analyses. The AIC values are obtained by using the summary command for the two glm() models: summary(glm.00) and summary(glm.30).

Laboratory Report

Your lab report should contain seven parts**: *Cover Sheet, Abstract, Introduction, Methods, Results, Discussion and References***. In the ***Introduction*** explain why you did the experiment. In the ***Methods*** section describe what you did. In the ***Results*** section present your findings, including graphs of your data. In the ***Discussion*** of your results, here are some important questions to answer. Is there a systematic relationship between the speed of motion and your response probabilities? Does your ability to detect motion depend on the luminance condition?

Your lab report should be brief and contain the seven sections: cover page, abstract, introduction, methods, results, discussion, and references. These sections should conform to the American Psychological Association (APA) style as described in Chapter 13 of the Martin book. The results section should contain the graphs plotting your data and the group data from the class. The report is due at lab

meeting (4 **and 6 March 2014**). Late labs will receive a grade of zero. All lab reports must be prepared with a word processor. It is worth 50 points.

Lab 3: Equiluminance Motion

Appendix I: Equiluminance Values
(degrees of elevation in the DKL Color Space)

Trial	Degrees
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Mean	

Appendix II: Summary of your data analysis.

Initials	mu.00	mu.30	jnd.00	jnd.30	aic.00	aic.30

References

Cavanagh, P., Boeglin, J., & Favreau, O. E. (1985). Perception of motion in equiluminous kinematograms. *Perception, 14*, 151–162.

Derrington, A. M., Krauskopf, J., & Lennie, P. (1984). Chromatic mechanisms in lateral geniculate nucleus of macaque. *The Journal of Physiology, 357*(1), 241-265.

MacLeod, D. I. A., & Boynton, R. M. (1979). Chromaticity diagram showing cone excitation by stimuli of equal luminance. *Journal of the Optical Society of America, 69*(8), 1183-1186. doi: 10.1364/JOSA.69.001183

Ramachandran, V. S., & Gregory, R. L. (1978). Does colour provide an input to human motion perception? *Nature, 275*(5675), 55–56. doi: doi:10.1038/275055a0

Scase, M. O., Braddick, O. J., & Raymond, J. E. (1996). What is Noise for the Motion System? *Vision Research, 36*(16), 2579-2586. doi: 10.1016/0042-6989(95)00325-8

Yantis, S. (2014). *Sensation and perception*. New York, NY: Worth Publishers.