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SAMPLE ORIGINAL LAB EXERCISES FROM SENSATION AND PERCEPTION PSYC 315

Although I use a wide variety of lab exercises and some, of course, are developed and distributed by educational services and publishers ***the projects described here are ones that I developed either mostly or completely.***

Lab 1. Original exercise with software written by former Millersville student.
*Thresholds Determination by method of Limits***.** This is an original lab based on a demonstration that I developed with my graduate advisor, David Northmore. After arriving at Millersville, I recruited Millersville student and savvy computer programmer, Brett Graham, to develop the associated program for use in my Sensation and Perception courses. Brett went on to earn a Ph.D. at the University of Delaware and now is an electron microscopy engineer at Harvard.

Lab 2. Completely original exercise.
The Limits of Visual Acuity Beyond the Central Field. This low-cost exercise illustrates how poor our visual acuity is in all but the very center of our visual field.

Lab 3. Completely original exercise.
Modeling Lateral Inhibition and Mach Bands in Excel. This is a completely original exercise that introduces students to the basics of computational neuroscience. A video tutorial for this lab is on the CD contained the supporting digital material.

Lab 4. Completely original exercise.
Objective Measurement of Visual Acuity. This is a low-cost lab exercise that illustrates how a physician or animal researcher can estimate the visual acuity in a nonverbal subject.

Lab 5. Completely original exercise.
Size Constancy and the Holway-Boring Experiment. A modification of this original, low-cost exercise is detailed in my publications (Gallagher and Hoefling, 2013). It illustrates the importance of environmental cues in estimating the size of objects.

Lab 6. Completely original exercise with "home-made" apparatus.
Measuring Depth Acuity with the Howard-Dolman Apparatus. I obviously did not invent the Howard-Dolman apparatus, but I did build two of these devices from scratch (one is pictured on page 20) for the classroom demonstration that I developed. I use the device to illustrate how much better depth acuity is when a participant uses two eyes, compared to only one.

Lab 7. Completely original exercise.
Face Recognition. This is a low-cost lab project demonstrates how asymmetrical most of our faces are and how most of us use only one half of a face for recognition.

Lab 8. Completely original exercise.
Two-Point Threshold and Tactile Acuity. This is a low-cost lab exercise that shows the similarities between tactile acuity (touch sensitivity) and visual acuity.

LAB 1

THRESHOLD DETERMINATION BY METHOD OF LIMITS

Background

This is an experiment to determine visual thresholds using one of the classical psychophysical procedures devised by Fechner, the Method of Limits. Fechner determined that your ability to detect a difference in the intensity of two stimuli depended not on the absolute difference between them, but the relative difference. That is, one light stimulus, called a comparison stimulus, would need to be, for example, at least 10% brighter or dimmer than a standard stimulus in order for you to see a difference between them. This means that if a standard stimulus had an intensity of 10 units, a comparison would need to be at least one unit brighter (11 units or more) or one unit dimmer (9 units or less) to be perceived as different from the standard. Similarly, if a standard stimulus had an intensity of 200 units, a comparison would need to be at least twenty units brighter (220 units or more) or twenty units dimmer (180 units or less) to be perceived as different from the standard. The ***difference threshold*** (**DL**) is the smallest detectable difference between two stimuli and when calculated as a function of the standard, the result is a linear relationship between the standard stimulus (***S***) and difference threshold (***DL*** from the German *Differenze Limen*). The relationship can be expressed like this:

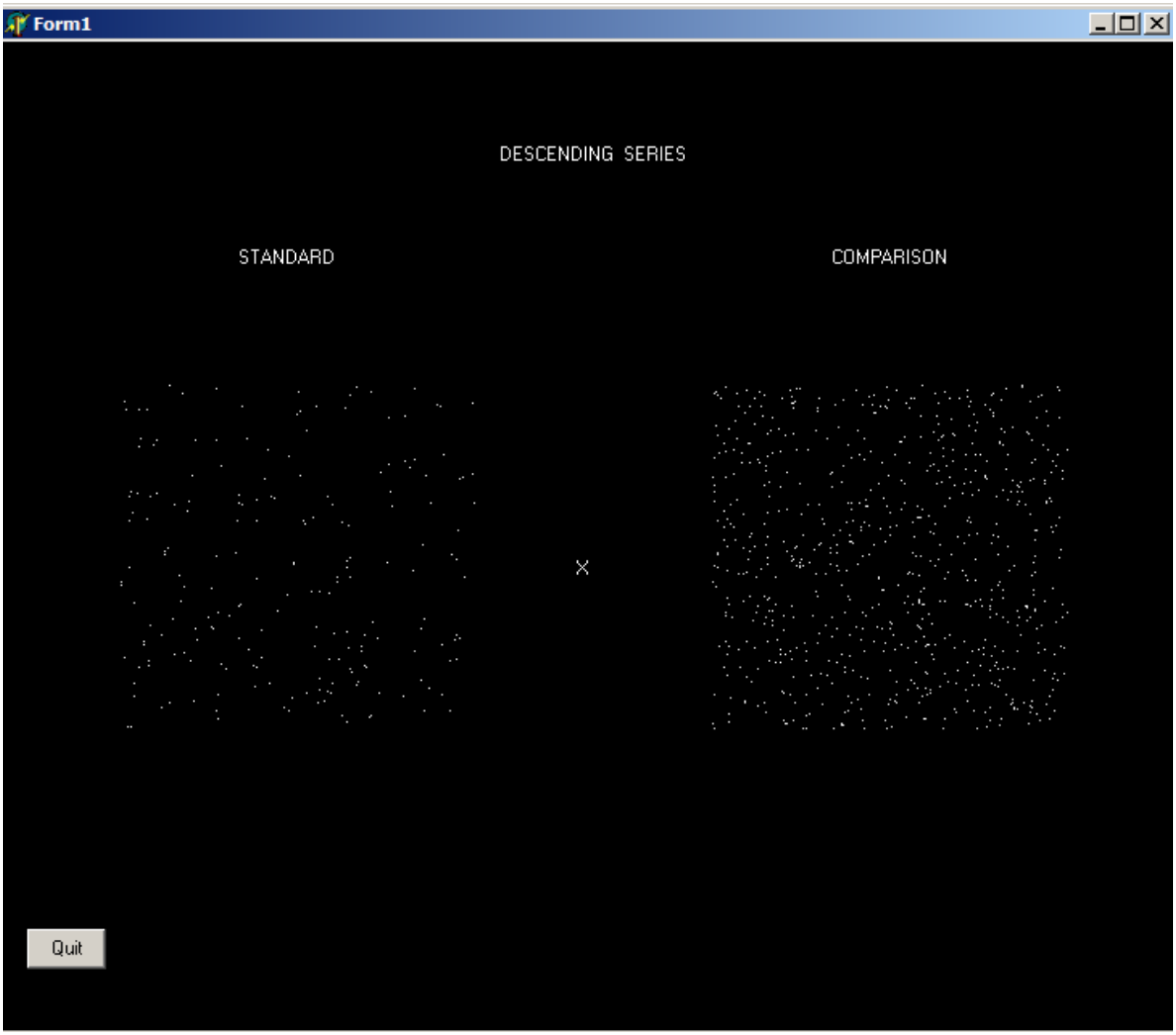
$$DL = k\,S$$

This relationship is known as ***Weber's Law*** and ***k*** is a constant known as ***Weber's Fraction*** (Weber was Fechner's mentor). In the example provided above, ***k*** would be 0.10 and the difference threshold (***DL***) would be 10% of the intensity of the standard (***S***).

Procedure

You will use the provided software program to conduct an intensity discrimination in which the participant (you) must judge the relative brightness of two stimulus patches. Although the computer display monitors cannot deliver visual stimuli with finely graded intensities, it is possible to simulate fine gradations in intensity with patches of randomly distributed dots of different density. Despite the fact that the stimulus patches appear speckled, rather than uniform, the results are nevertheless valid and lawful. In what follows, "stimulus intensity" = Number of dots per patch.

The stimuli will look like this:



Most would judge the patch on the right as brighter, but be warned, the patches are not all this easy to discriminate and they will appear only briefly, so stay alert.

You will be measuring Difference Thresholds (***DL***), i.e. just noticeable differences in intensity from a standard intensity. On each trial, a fixation point, X, will appear in the screen center, flanked a few seconds later by two rectangular speckle patches. The left patch is the fixed "Standard" stimulus; the right the variable "Comparison" stimulus. Your task is to indicate whether Comparison is noticeably ***different*** from Standard in terms of intensity (i.e. dot density). Initially, the Comparison is the more intense. After a ***Yes*** response, the Comparison will become less intense on the next trial. (Because the comparison patch is approaching the standard from above, we will refer to this as a **descending** series.) After a ***No*** response, the program stores the current intensity difference between Standard and Comparison as the "Descending Limit" - this value is an estimate of the difference threshold for that trial. An **ascending** series then begins with Comparison below the Standard intensity, with Comparison increasing trial by trial until a ***No*** response is again given, when the "Ascending Limit" is stored. Ascending and descending series are alternated.

The objective is to measure difference thresholds for each of a range of values of Standard intensity, and plot these difference thresholds against Standard intensity. If the data points fall close to a straight line you can conclude that the difference threshold is proportional to the Standard intensity, as implied by Weber's Law.

Start the Method of Limits program by double-clicking MOLproj.exe. Click the "About" button to review the instructions. On a piece of scratch paper, draw up a list of 6 Standard intensities using 25, 50, 100, 200, 400, and 800 dots per stimulus patch. You should run a total of 30 series (15 ascending, 15 descending) with each Standard. QUIT THE PROGRAM AFTER EACH SET OF 30 and restart the program using a new data file name each time you change standard intensities. This will keep your finished trials safe in the event of a PC crash. Give each data file a **UNIQUE** name that identifies you and the standard intensity used. For example, if John Doe ran the experiment with a standard intensity of 25, a possible file name would be **JD25.txt**. Adding ".txt" to the end of your file name lets windows know that your file is a text file. The data files will be created in the same directory that holds the molproj.exe file (if you downloaded molproj.exe to your desktop, the data file should appear there also). When you are finished, you should have 6 data files saved.

Program options include:
Name your data file by typing text in the white box in the upper right of your screen.
Set Parameters allows you to set the Standard intensity and stimulus duration. Leave Stimulus duration at 300 throughout this lab.
Start Series triggers the stimulus presentation. Remember to look at the "x" in the center of the screen.
Quit stops the program and saves and closes your data file.

Reading Data Files
You can open a data file directly into a word processing program or Microsoft Excel if you have ".txt" at the end of the file name. In your data files, each ascending and descending series gives you one estimate of the difference threshold (**DL**) under **Limit**. This value is the crossover point between 'yes' and 'no'. For example, if on a descending series the last yes was at a standard-comparison difference of 40, and the first 'no' was at a difference of 35, the estimate of **DL** will be 37.5. For each Standard intensity, average the ascending and descending **DL**'s together, and calculate the standard error ($SE = SD/\sqrt{n}$). In your data file, descending series are indicated by Direc = -1; ascending series by Direc = 1. Determine the mean **DL** and the standard deviation of the mean for each standard intensity. ***Your table should be completed today and look like this:***

Standard	Mean DL	SE of Mean DL
25		
50		
100		
200		
400		
800		

Assignment Part 1.

1. Use the table above to create a scatter plot that illustrates the relationship between Standard intensity (x-axis absicca) and ***DL*** (y-axis or ordinate). You should have six plotted points with error bars extending one ***standard error*** above and below each plotted mean. Label all features of the scatter plot appropriately and include an APA style figure caption ***below the scatter plot***. You may create the figure in Excel or any other graphing application, but the final product must follow APA style. DO NOT PUT A TITLE ON YOUR GRAPH. Please review the procedure for constructing APA figures. Conduct a linear regression analysis to determine the equation of the line that represents the relationship between Standard and Mean ***DL***. Put this equation on your scatterplot along with the line that represents the equation.
    a. 25 Points Possible for the Figure (sample below)
        - Appropriate scatterplot – 5 points
        - Correct equation – 5 Points
        - Appropriately formatted and labelled axes – 5 points
        - APA formatted figure and caption – 10 Points

Assignment Part 2: Title Page, Abstract

Finalize your figure incorporating the feedback that I provide (if any).

1. Weber's Law $\boldsymbol{DL} = \boldsymbol{k}\,\boldsymbol{S} + 0$. (Do you understand why? Look at chapter 1 of Goldstein). Rewritten like this, hopefully you can see that Weber's law is the equation of a line (y=mx+b). Your line of best fit represents Weber's law. The slope of your line is **k**, or the Weber Fraction. The equation of your line of best fit will simply be a restatement of Weber's law with the value of the slope of your line substituted for k. Put the equation on your scatter plot. **(5 points)**
2. Create an APA style title page and APA style abstract (300 words max.) that describes this experiment and make sure it addresses the following questions (25 points):
    a. Was Weber's Law obeyed?
    b. Compare your y-intercept with that predicted by Weber's Law (what would you predict?). The slope gives the Weber Fraction, (see Table in the book. How does your ***k*** compare to these values?).
    c. If you were an exceptionally sensitive subject, would your ***k*** be higher or lower than most others?

You should submit a three-page document **via D2L Dropbox**. A 5-point deduction will be applied to any assignment that is not complete at the beginning of lab in two weeks.

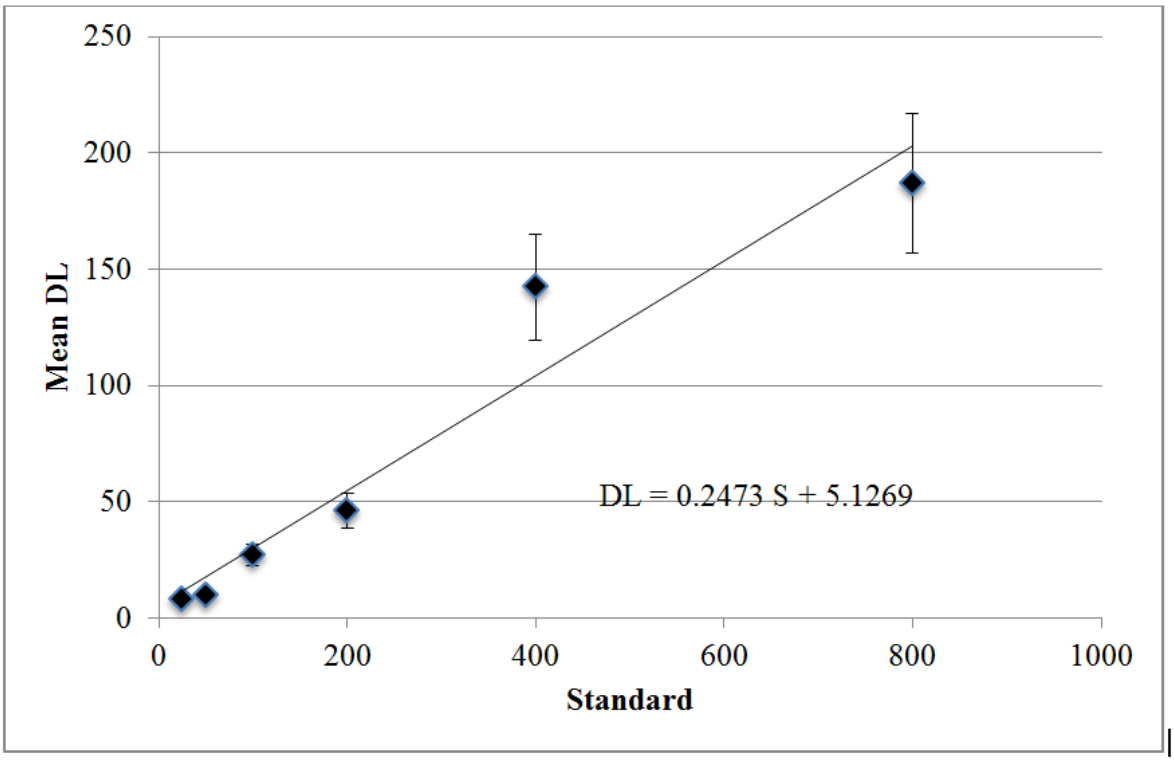


Figure 1. Scatterplot showing the relationship between standard intensity and mean difference threshold (DL). Error bars represent standard errors.

LAB 2
THE LIMITS OF VISUAL ACUITY BEYOND THE CENTRAL FIELD

Background

As stated in class and in your text, the anatomy of the retina leads to inherent variability in the quality of our visual scene; the centers of our visual fields have the best resolution and are good at detecting color and fine detail, but the sensitivity of our vision falls dramatically as an object moves from the center to the periphery of our visual fields. These simple experiments will demonstrate the limitations of your peripheral vision.

Procedure

Color Acuity Exercise: Face a uniformly illuminated surface like a flat painted wall with no signs, electrical outlets or ductwork. Place a small piece of tape on the wall in front of you at eye level and place a small "X" on the tape (not the wall). This X will serve as a fixation target. You should keep your eyes on this spot at all times. While staring at the target, extend one arm out to the side and parallel to the ground. Have an assistant place a dark colored crayon (dark green, blue, brown, red, or black) in your hand and without bending your elbow, slowly swing your arm forward until the crayon is in the center of your vision. While your arm is moving, USE YOUR PERIPHERAL VISION, to identify the color of the crayon. Repeat the test several times with both arms. How close to the center of your visual field do the crayons have to be before you **consistently** correctly identify the colors? Can you use your results to estimate the size of your "field of color vision?" Can you express it in degrees of visual angle? If your eye is 30 cm from a piece of graph paper, each square is approximately one degree tall and wide. How do your results compare to the distribution of cones illustrated in the "hill of vision" in your text?

Note: Many people assume that, because we cannot see colors well in our peripheral fields, we must be using rod vision in our periphery. **This is not the case!** The reason color vision is poor in the periphery is because cones converge and "pool" their signals; long wavelength cone signals are mixed with medium and short and the brain gets a generic "light" message.

Central Acuity Exercise: This exercise is similar to the color vision exercise, but will involve a little more measurement. Print the sheet on the final page of this assignment and tape it horizontally to a wall so the long heavy line is horizontal and at eye level for a seated participant. Orient the sheet so the heavy cross is to the right. Position a participant in a chair facing the sheet with the bridge of their nose (between the eyes) approximately 30 centimeters from the center of the sheet (Use a ruler – this is about 1 foot). Cover the participant's RIGHT eye and instruct them to look at the center of the heavy cross with their LEFT eye. I will supply an array four different types of letter strips; each has letters in one of four font sizes (see table below). While the participant's LEFT eye is staring at the fixation point, slowly slide the letter strip from the edge of the paper toward the fixation point. Slide vertical letter strips from the side edges of the graph paper toward the center and slide horizontal letter strips from the top and bottom edges toward the center. Have the participant say "stop" (at which time the experimenter should stop sliding the strip) and read the letters when they are able to see them *clearl*y. Make note of the position of the center of the letter strip and ***write the number that appears on the back of the letter strip at that point.*** Repeat this process so each letter strip size is presented from all four approaches. You should have 16 points plotted when you are finished. Be sure to vary the letter strips so your participant doesn't start memorizing the sequences. Take

the data from the participants used in the experiment and create a bar graph showing the mean maximum distance (from the fixation point) at which the letters can be read. Each square on the graph paper is approximately one-degree square if the participant is 30 cm from the wall so measure your distances in degrees. Complete the table below:

Table 1: Maximum mean distance from fixation (in degrees of visual angle) at which each font can be read

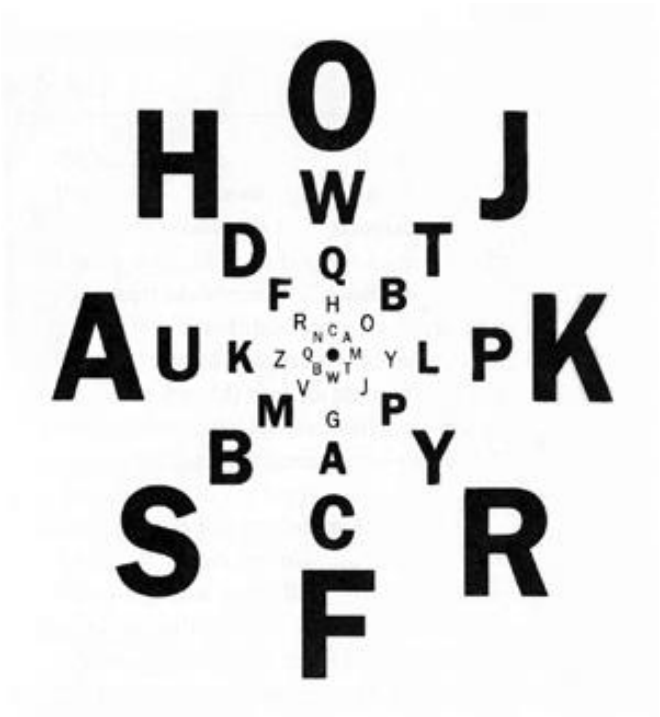
Letter Size	Font Size	Superior Field	Inferior Field	Nasal Field	Temporal Field	Mean	SEM
1							
2							
3							
4							

Blind Spot Plotting: Using the same sheet of graph paper plot the location of right eye's blind spot by moving a target, such a piece of black tape on a straightened paperclip, leftward from the fixation point along the horizontal axis. Ask the participant to tell you when the target disappears. Once you have found the blind spot, refine your technique with smaller pieces of tape and try to precisely measure the shape and size of the blind spot.

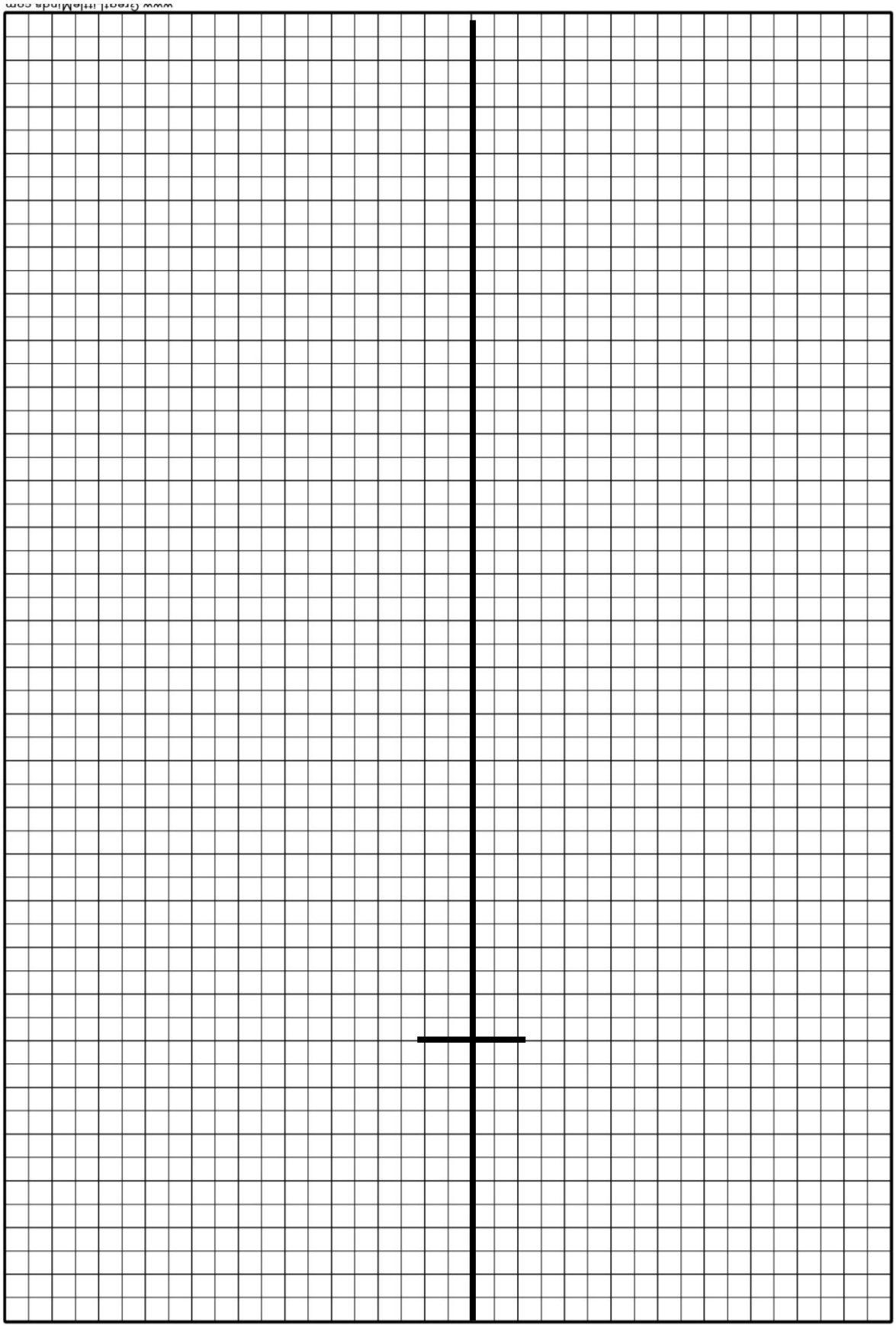
Assignment (Three pages)

1. Create an APA style figure with a bar graph that represents the results from your table (show four means with standard errors) and conduct a One-Way ANOVA to demonstrate that the mean maximum distance at which the letters can be seen is not the same for all font sizes. Report the value of the appropriate inferential statistic in the abstract and figure caption and state whether or not the results are statistically significant. The caption should clearly describe the figure for someone who did not witness the experiment.
2. Using APA style, create a title page.
3. Write an APA style abstract that describes both the **Central Acuity** experiment and the **Blind Spot** experiment as if you were submitting them as part of a single complete scientific paper. Address the following in your abstract:
    a. Clearly state your hypothesis (What is the hypothesis, you ask? Think about the inferential test I asked you to perform. Why do we expect visual acuity to be best in the center of your visual field?)
    b. Why and where do you have a blind spot? Although there are no calculations to perform for the blind spot plotting, report its location and size (e.g. *The left eye's blind spot was centered _____ degrees to the left of the fixation point and it was _____ degrees in diameter*.)
    c. Clearly describe your methods so a reader can understand what has been done
    d. Clearly describe your results and link them to your hypothesis

Font Size	Sample
8	E
10	E
12	E
14	E
16	E
18	E
20	E
22	E
24	E
26	E
28	E
30	E



Lab 2, Figure 1. Table showing the Arial font sizes of the letter E (left) and a special chart prepared to demonstrate how visual acuity decreases rapidly with target distance from the fovea (right). According to Anstis (1974), when the center of the chart is fixated at approximately normal reading distance, all the letters should be equally legible, since increasing target distance from the fovea is offset by a corresponding increase in letter size. [Anstis, S. (1974). A chart demonstrating variation in acuity with retinal position, *Vision Research*, 14, 589-592.]

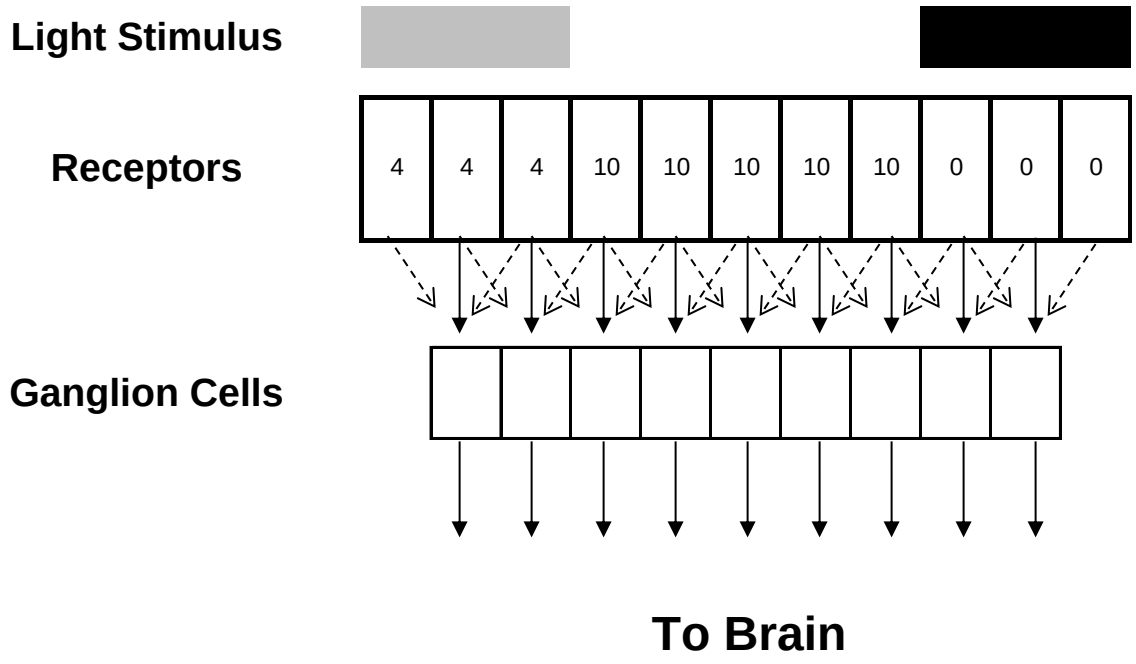


LAB 3
MODELING LATERAL INHIBITION AND MACH BANDS IN EXCEL

Background

Basic Lateral Inhibition and the Mach Band Illusion: Lateral inhibition can be demonstrated in the senses that process spatial organization, particularly vision and mechanoreception (touch). Primary sensory neurons relay their messages to secondary receptors in different ways. Some secondary receptors receive direct excitatory input, while others receive inhibitory signals. This arrangement enhances edge detection by making the perception of the boundary sharper than the actual physical stimulus. *Lateral inhibition enhances edges and facilitates detection.*

The illustration below represents the responses of an array of primary photoreceptors (rods and cones) and secondary receptors (retinal ganglion cells or RGCs) that receive their neural responses through a synaptic connection. In this illustration, and the network we will build, we will always assume that the RGCs receive excitatory synapses from the photoreceptor directly above them and inhibitory synapses from the photoreceptors on either side of the one directly above (the lateral receptors). The solid arrows represent the excitatory connections. Dashed arrows represent inhibitory connections.

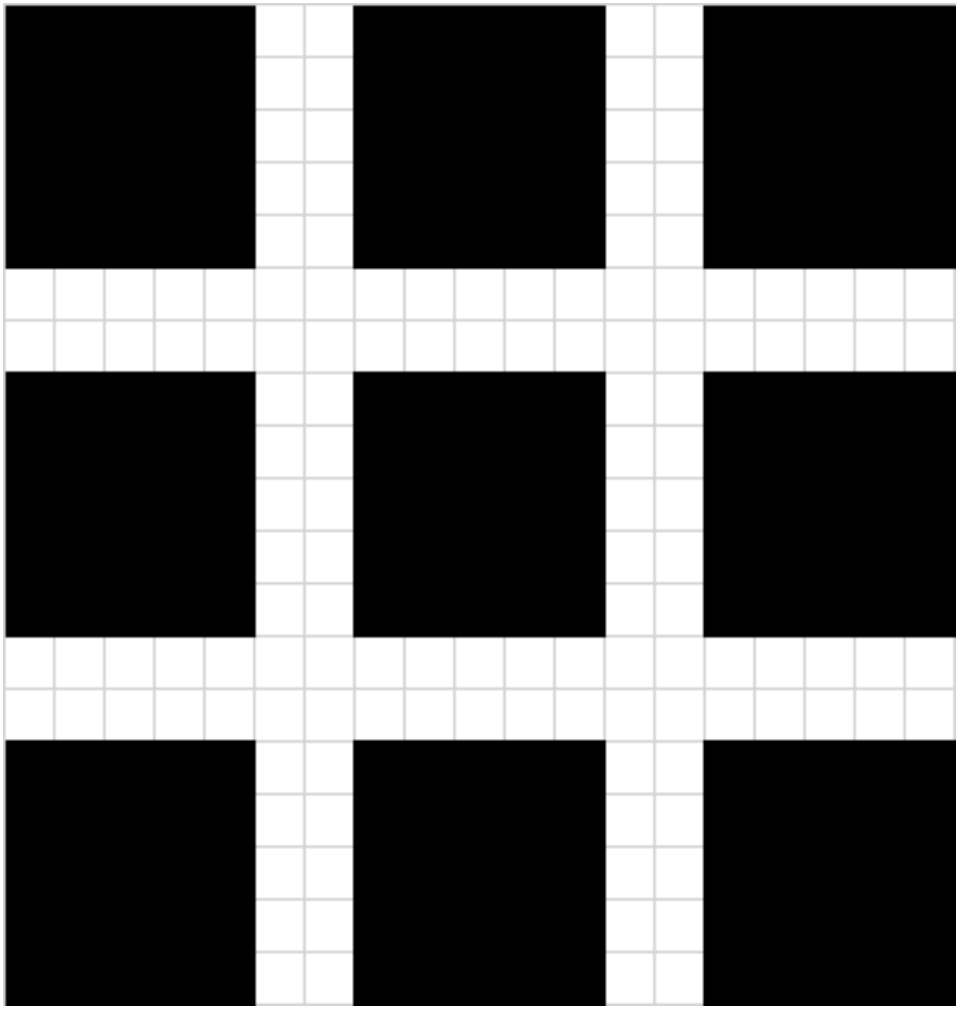


Assuming the inhibitory synapses (dotted arrows) are one-quarter the strength of the excitatory synapses (which are +1), place numerical values in the ganglion cell boxes that show their activity. You should find that the activity represented in the boxes reflects the pattern of the light stimulus (i.e. Low Light to Bright Light to Darkness) but the differences observed at the boundaries will be greater than the differences that actually fall on the receptors. A single, basic, processing strategy gives the network the ability to enhance edges. Sometimes the effect makes the light side of a light-dark boundary appear unusually bright and the dark side of the boundary unusually dark. This illusion was described by German physicist Ernst Mach more than a century ago, long before the mechanism behind the illusion was understood.

Are these results consistent with the perceptual illusion of Mach Bands? (That is, Does the ***mathematical model*** explain the ***perception*** of Mach bands?)

Assignment Part 1: I have created a D2L content folder called **Lateral Inhibition** for these assignments. Using the video instructions that I loaded on D2L (ExcelMachBands.mov) and the Excel Workbook I provided (Mach_Template.xlsx) create an Excel model of the network above and see if the activity in your network matches the calculations you made here. Rename the template file with your initials (for example, MachBandsXX.xlsx, and substitute your initials for XX).

Lateral Inhibition and the Hermann Grid: The Mach Band Exercise used a "one-dimensional" model of receptor cells and ganglion cells. Now, we will expand our model to two dimensions. A Hermann Grid appears below and most observers see shadows that appear at the intersection of the white bars that run between the black squares. This illusion, like Mach bands, can be explained with a lateral inhibition model.



The figures below represent how the Hermann Grid stimulus is represented in the retina; first at the photoreceptors (left), then at the level of the retinal ganglion cells (right). The shading and numbers represent the light intensity patterns that are falling on each one. These cells then project to an array of retinal ganglion cells (represented on the right). Each receptor sends an excitatory message to the ganglion

cell directly below it. It also sends an inhibitory message to the EIGHT neighboring ganglion cells. As with the Mach band demonstration, assume that all of the excitatory connections are **+1**, but now assume that the inhibitory messages are **-0.1.** use the lateral inhibition model to illustrate the activity that you would expect in each of the retinal ganglion cells. (The gray color you see on the Retinal Ganglion Cells is only there to help you match the receptors to the ganglion cells and do not necessarily reflect the activity levels of the cells.)

Light Pattern Falling on Receptors

10	10	10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10	10	10
10	10	2	2	2	10	10	2	2	2	10	10
10	10	2	2	2	10	10	2	2	2	10	10
10	10	2	2	2	10	10	2	2	2	10	10
10	10	10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10	10	10
10	10	2	2	2	10	10	2	2	2	10	10
10	10	2	2	2	10	10	2	2	2	10	10
10	10	2	2	2	10	10	2	2	2	10	10
10	10	10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10	10	10

Activity Pattern of Retinal Ganglion Cells

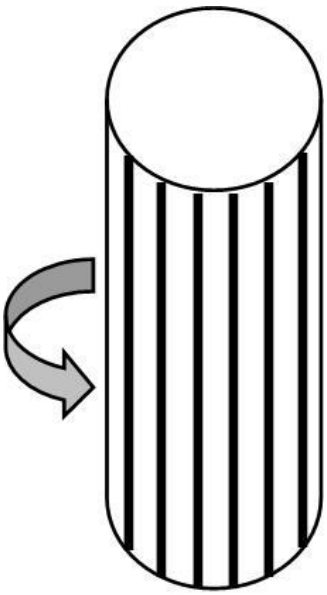
X	X	X	X	X	X	X	X	X	X	X	X
X											X
X											X
X											X
X											X
X											X
X											X
X											X
X											X
X											X
X											X
X	X	X	X	X	X	X	X	X	X	X	X

Identify similar values on your completed grid and see if the numerical patterns can be used to explain the Hermann Grid illusion (it should!). Note that both illusions can be explained with the basic lateral inhibition model.

Assignment Part 2: Using the video instructions I loaded on D2L (ExcelHermann) and the associated Excel template (HermanTemplate.xlsx), create an Excel model of the network above and see if the activity in your network matches the calculations you made here and if the numbers are consistent with the Hermann Grid Illusion. Save the file and give it an appropriate name with your initials (for example, HermannGridXX.xlsx, and substitute your initials for XX).

LAB 4
OBJECTIVE MEASUREMENT OF VISUAL ACUITY

Optokinetic nystagmus (OKN) is a complex motor reflex that allows our eyes to follow moving objects when we keep our head steady or keep our eyes on stationary objects when our head moves (Try shaking your head from side to side while looking at this printed page and notice how easy it is to maintain a stable image). OKN served to keep a moving image stationary on the fovea; the better your visual acuity is, the more sensitive the OKN will be. The reflex is present in a crude form in newborn infants and improves with visual acuity. THE OKN is, therefore, an excellent way to indirectly measure visual acuity in preverbal and nonverbal individuals. When a subject views a rotating striped drum (see figure below), the involuntarily follow a stripe with a "slow eye movement" (SEM), then return with a fast eye movement (FEM) to fixate on a new stripe. The whole cycle can be repeated indefinitely as long as the subject views the moving drum.



Procedure

In this experiment, you will observe the normal OKN in response to a rotating striped drum. Set the drum up on a table so it rotates around a vertical axis at eye level for a comfortably seated subject. To start, the subject should view the drum at a distance of about 40 centimeters. Start the motor, select a speed, and keep the drum spinning at this speed throughout the experiment. The exact speed of the drum is not important; try to spin the drum at a quick, steady pace, but not so fast as to blur the passing stripes.

Instruct the subject to look at the spinning drum and observe the subject's eye movements. This movement is involuntary and, as long as the subject is looking at the drum, uncontrollable. Move the subject farther and farther away from the drum and make note if the distance at which the OKN is no longer apparent. Repeat the procedure with other subjects. Do all subjects lose the OKN at the same distance? Cover one eye at a time. Is the OKN as obvious when the subject is viewing the drum with only one eye?

Recruit some volunteers from those students who wear corrective lenses (at ages 18-22, these people are

usually myopic) and ask them to repeat the experiment without their glasses or, if practical, contact lenses. Do these subjects lose the OKN at shorter distances than those with normal visual acuity? Why? How do these subjects compare to those with normal vision? Can you estimate an individual's visual acuity (not nearsighted, a little nearsighted, very nearsighted) by the distance at which they lose the OKN?

Clinical Significance

A number of visual problems can generate abnormal OKN's, however a normal OKN *only* indicates that (1) the macula is getting a good image of the stripes and (2) the oculomotor pathway from the retina to the brainstem and back to the eye muscles is functioning properly. It is important to know exactly what a normal OKN indicates and what it does not indicate. For example, a fashion-conscious teenager may, despite having perfectly normal vision, have his heart set on wearing glasses and claim that he is nearsighted and that everything more than a foot away from his face is a blur. Spinning a striped drum at a distance of two or three feet would expose his deceit or, as clinicians call it, "malingering." Likewise, even the most uncooperative nonverbal children can be quickly evaluated and, in such a case, a normal OKN is good evidence of reasonably intact vision.

OKN testing is performed routinely by many eye care providers, both in the clinical setting and on vision screenings. However, there are several concerns about this technique. First of all, even though the stripe width can be measured and recorded, the test is not well standardized. The speed of the drum, for example, is difficult to control and may provide variations in results. It is not known how the stripe width in OKN testing corresponds to Snellen visual acuity (20/20, 20/40 etc.). The second concern arises from the fact that the OKN response has been elicited in those who have suffered stroke damage to the visual cortex or higher visual cortical areas as well as those with extensive peripheral vision loss due to glaucoma or diabetic retinopathy. Thus, it is possible to get normal OKN responses from people with significant visual impairments.

Lab 5
SIZE CONSTANCY AND THE HOLWAY-BORING EXPERIMENT

This exercise is a modification of the Holway-Boring experiment and the objective is to test your ability to estimate size without the benefit of depth cues. Two or more students will serve as the experimenters (E) while the rest of the class will serve as subjects (S). The Es will be in the one room while the Ss will remain in an adjacent room. A window between the rooms will be covered except for a small peephole. The Es will cover and uncover the peephole from inside their room in order to allow the Ss to view glow-in-the-dark squares placed in different locations at eye-level inside another room. With the aid of numbered comparison squares located with the Ss, each S will look into the adjacent room and attempt to guess the size of the four squares with and without the help of depth cues.

Dark Condition.
In this part of the experiment, the Es must be careful not to let the Ss view the squares while the room is illuminated. The experiment will begin with the Es inside their room with the lights on and with the peephole covered. Each S will approach the window and knock once. At this signal, the Es will (1) TURN OFF THE ROOM LIGHTS and (2) UNCOVER THE PEEP HOLE. The S will look into the room with one eye and first identify the glowing squares (make sure you see 5 before guessing), which will be arranged in a horizontal line at eye level. By looking back and forth between the test squares and the eight comparison squares, S will record the sizes of the glowing squares from left to right. Each test square matches the size of one of the comparison squares. The numbers on the comparison squares (1-8) represent the length of a side in inches (we'll convert to centimeters later). When S has estimated the sizes of the squares, S will knock twice on the window at which time E will (1) COVER THE PEEP-HOLE and (2) TURN ON THE ROOM LIGHTS in order to "recharge" the test squares. After the squares have had at least 30 seconds to recharge, the next S will approach the door, knock, and take a turn at estimating the sizes of the squares.

Illuminated Condition.
This procedure is the same as that for the dark condition, except that the Ss will be looking into an illuminated room and the Es will leave the lights on and can leave the peephole uncovered. The Ss should follow the same sequence.

Data Analysis

Pool the data from all Ss and calculate the mean estimated size of each square under the Dark and Illuminated Conditions (8 means). Generate two graphs in Excel. First create a graph with **retinal image size** (degrees) on the x-axis and **estimated size** (length of one side in cm) on the y-axis. Retinal image size must be derived from the height (in centimeters) of the square (H) and the distance (centimeters) between the peephole and the square (D). See the algorithm below to calculate retinal image size in degrees. Second, create a graph with **actual size** (length of one side in cm) on the X-axis and **estimated size** (length of one side in cm) on the Y-axis.

Graphing

Set up a table as follows for Graph 1

Sq.	Act. Size (cm)	Dist. (cm)	Image Size (Deg)	Est. Size Dark (cm)	Est. Size Illum. (cm)
1	7.5	199			
2	5.0	316			
3	12.5	372			
4	10	337			
5	2.5	93			

Set up a table as follows for Graph 2

Sq.	Actual Size (cm)	Est. Size Dark (cm)	Est. Size Illum (cm)
1	7.5		
2	5.0		
3	12.5		
4	10.0		
5	2.5		

Insert a linear trend line for the means calculated under each condition and have Excel display the r^2 value on the chart. This value represents the strength of the relationship; an r^2 value close to 1 indicates a strong positive correlation, while an r^2 value close to 0 indicates little or no correlation. Compare the strength of the relationships between Retinal Image Size and Estimated size in the Dark and Illuminated conditions. Which relationship is stronger? Evaluate the strength of the relationship between Actual Size and Estimated Size in the Dark and Illuminated conditions. Which relationship is stronger?

Calculating Retinal Image Size

1. Divide the square's height (H) by 2.
2. Take the result and divide it by the distance between the peephole and square (in cm).
3. Take the Arctangent of this result. This is half the image size in radians.
4. Convert to degrees.
5. Multiply by 2.

If H is the length of a square size in centimeters and D is the distance between the peephole and square in centimeters, the calculation will look like this in Excel

=2*DEGREES(ATAN((H/2)/D)).

Lab 6
MEASURING DEPTH ACUITY WITH THE HOWARD-DOLMAN APPARATUS

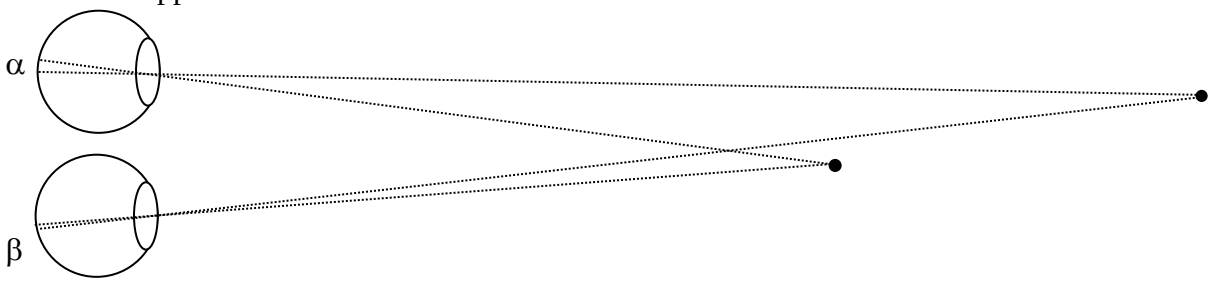
The purpose of this experiment is to study how judgments of depth, are affected by: (1) monocular versus binocular stimulation; (2) the distance between eyes and target. You will measure depth acuity using the Howard-Dolman apparatus, a device that allows adjustment of the position of a pair of vertical rods until they appear in the same plane.

METHODS

Work in 2 groups: S – subject (designate four); E - experimenter.
(1) S is positioned so that only the rods are visible through the window of the apparatus. Choose two different eye-rod viewing distances (1 and 3 meters). S should make all settings with head still.
(2) At one of the predetermined viewing distances, S uses both eyes to set the two rods at the same apparent distance. E records S's setting of inter-rod distance (i.e. S's error) by using the scale on the back of the apparatus. E then randomly repositions the rods for the next setting. S makes 20 settings under each viewing condition. S must not hold the strings while E is resetting the rods. E should record S's ABSOLUTE error. (3) S makes another 20 settings with only one eye.
(4) Repeat 2 & 3 at the other viewing distance.

ANALYSIS

(1) For each of the 4 viewing conditions (far/near, monocular/binocular), plot S's errors in histogram form.
(2) Perform t-tests or other suitable statistics to show whether there were significant effects of viewing distance and mono/binocularity.
(3) Convert the mean errors under the binocular conditions into disparities.
The disparity angle (p) is given by $\mathbf{p = B.E/D^2}$ where
B is the distance between the eyes (**mms**) (Measure S's!)
E is the mean absolute error (**mms**)
D is the distance of eyes to nearer rod (Viewing distance-E/2 **in mms**).
Since the resulting p is in radians, multiply it by 206,280 (57.3 deg/radian x 60 minutes/degree x 60 seconds/minute) to convert it to seconds of arc. You now have a measure of depth acuity. This angle represents the mean difference in angles α and β in the figure below, which approaches zero as mean difference approaches zero.



QUESTIONS

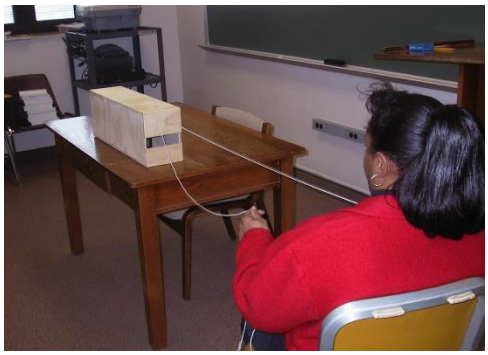
Explain the differences in mean error you obtained in the near-far and mono-binocular viewing conditions.
How does the disparity angle (measured only in binocular conditions) in the 1 meter condition compare to the disparity angle in the 3 meter condition?
What are the potential monocular cues to depth?
How did the procedure control for these?
Create a bar graph showing mean error for all conditions and standard deviation error bars.
ASSIGNMENT

1. APA Title page
2. An abstract with a clear explanation of what you are exploring and what you predict (three hypotheses). Explain the differences in depth acuity you obtained in the near-far and mono--binocular viewing conditions. Why are monocular and binocular conditions different and what are the potential monocular cues to depth?
3. One APA-style figure showing the performance of the participant and within-subjects analysis to explore statistically significant differences among conditions. Statistical results should be reported appropriately in the abstract.

Use the table below organize and collect data.

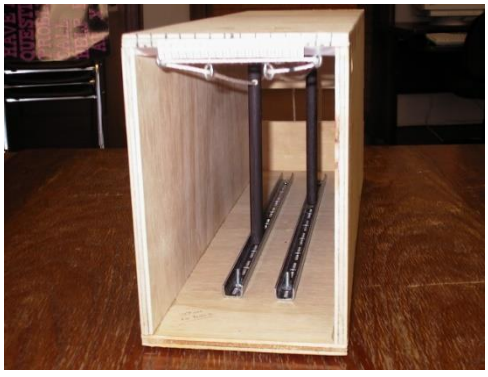
Part. 1 IPD = mm	**B 1m**	**B 3m**	**M 1m**	**M 3m**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Mean Error				

Use of the Howard-Dolman apparatus to test depth perception



A student is testing her depth perception with the Howard-Dolman apparatus.

The Howard-Dolman apparatus as viewed by the student. The task is to use the string to place the identical black rods side-by-side. Using the apparent width of the rods as a cue, the rod on the right is judged to be closer than the one on the left.



View of the Howard-Dolman apparatus from the back showing the pulley and rail system that allows the user to position the black rods by tugging on one end of the continuous string.

Lab 7
FACE RECOGNITION

I will give you a great degree of "Experimental Latitude" with this project, but your hypothesis should be based on what we already know (or don't know) about face recognition.

Your book (and other sources) tell us that the temporal lobes have an area reserved for the processing of face information, however, it is not known if this area of the brain is equally active in both right and left hemispheres. Our knowledge of how the brain processes language comprehension and speech tells us that these functions are governed by the left hemisphere in most right-handed people. So, generate hypotheses based on the following:

1. We know that each half of the brain gets (direct) input from the opposite half of the visual field. If you look at the center of someone's face, the left half of their face (which is in the right half of your visual field) will be processed by the left half of your visual and extrastriate cortices.
2. If face information is processed predominantly by the right hemisphere, then the important face recognition information will be the information that is in the left visual field. (To exaggerate, this means, the right half of your face has all of the important "recognition traits" and must be present if someone is to recognize a photo of you. Additionally, the recognition traits must fall in the correct visual field. Therefore…
    a. The features on the left side of your face are not as important for face recognition as the features on the right side of your face and…
    b. To a friend or family member, a mirror image of your face won't look as much like you as a non-mirrored face.
3. If you create "mirror" faces of yourself, only one of the mirror faces will have the traits of the left side of your face and only one of the mirror faces will have the traits of the right side of your face. (see sample face below).
4. **Hypothesis: If only one half of your face has the important face recognition traits, then one mirror face will look much more like you than the other mirror face.**

Your job is to conduct and formally write up a scientific paper (APA format) by using this hypothesis or by refining and modifying it. You may also wish to consider things like handedness. For example, if face information is processed by only one hemisphere, perhaps left-handed and right-handed people process faces with different hemispheres. Consider the influence of things like gender and how long you have known the individual or any other factors that might play a role in recognition.

Bear in mind that this is going to be the largest lab assignment you will be given, so please spend some tile and discuss it with me as you develop your ideas. I can also offer suggestions to those of you who absolutely do not want photos of yourself circulating in cyberspace.

The image at left below shows an original portrait. The image in the center is a full face created by mirroring the left half of the photo and the one on the right was created by mirroring the right half of the photo. Which mirrored face looks more like the original? Your choice might depend on how you scan faces. Do you tend to look at the right eye or left eye (or both) when you are having a conversation?


Original Photo


Mirrored Right Half


Mirrored Left Half

Lab 8
TWO POINT THRESHOLDS AND TACTILE ACUITY

Work in groups of two or three and use the clipped paper clips to evaluate two-point discrimination thresholds on each other. Make sure the subject has eyes closed or is looking away while guessing if they are being touched by one or two ends of a paper clip on different locations on the body. Use the table below to record your results. Use a method of limits approach to evaluate thresholds at each location. Print this page and use the handy micrometer at the bottom of the sheet to calibrate your paper clips. Test a number of locations but be sure to measure the two-point threshold of the tips of the participant's index fingers. Repeat at least four times for each fingertip to get a mean and standard deviation. Also make note of the hand that the participant uses for writing. Hold on to your results as you will need them for a short quiz to be given at the end of lab.

Participant:

Location	**Threshold using MOL (mm)**	**Threshold using 2AFC (mm)**
Tip of right index finger:		
Tip of left index finger:		

Participant:

Location	**Threshold using MOL (mm)**	**Threshold using 2AFC (mm)**
Tip of right index finger:		
Tip of left index finger:		

Participant:

Location	**Threshold using MOL (mm)**	**Threshold using 2AFC (mm)**
Tip of right index finger:		
Tip of left index finger: