**NSCI 20100 Neuroscience Laboratory**

**Contrast Increment Thresholds**

**Remote Lab, January 19-21, 2022**

**Goals:** In this lab, you will examine the Weber-Fechner law by measuring your visual contrast increment threshold on different background contrasts. You will collect a substantial psychophysical data set that will allow you to quantitatively assess the relationship between background contrast and contrast increment threshold. You will gain experience with challenges of obtaining high-quality threshold-level behavioral performance, and intuition for the number of trials needed for reliable measurement of binomial variables. This lab will also introduce you to the process of preparing a well-formulated lab report.

**Reading:** You should review the material on Significant Digits on the Canvas site.

**Safety:** There are no lab safety issues related to this study. You will be working only with a desktop computer and its visual display.

**Data:** You will collect psychophysical data using five increments at each of five different base contrasts (25 different conditions).

**Clean up:** When you have finished, you should quit Matlab, gather any data files from the computer and discard your files on the lab machine. You do not need to log out, reboot or shutdown the computer.

**Lab Report:** Lab reports should be prepared following the general instructions from lecture and the Canvas site. In preparing your report, you should consider the following:

Your report should start with a brief overview to explain the question that the lab addresses and the experimental approach. You do not need to provide an exhaustive description. The goal is to provide enough information that your target audience (another NSCI major who hasn’t taken the course) will understand the rest of the report.

You should complete the analyses described in the lecture and present figures that describe your findings comprehensively but concisely. Point out features of your data that are consistent or inconsistent with the hypothesis that at all base contrasts a certain minimum contrast change is needed before any stimulus can contribute to a percept.

Your discussion can also be brief. What is required is statement of what you think readers should take away from the data and presentation.

**Laboratory Procedures**

You will use a Matlab application to collect your data. The necessary software is installed and configured on each of the lab’s computers. Use the following procedures to run the software.

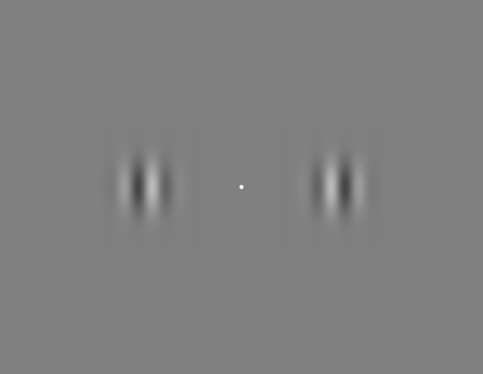
1) Log into the “labuser” account. There is no password for this account: leave the password field empty if you are asked for a password.

2) Launch Matlab by clicking on the Matlab icon in the dock at the bottom of the display. (Matlab might have a date appended to its name, such as “Matlab\_2021b”.)

3) When it launches, Matlab will display a large, multi-paneled window. Launch the Contrast Threshold application by entering the command *contrastThresholds* (no space) in the “Command Window” at the bottom of the Matlab multi-panel window.

4) The Contrast Threshold application may take up to 10 s to launch. Once it has finished launching, you will see a display window and a control/data window, which are described below.

5) When you have finished collecting and saving your data, you can terminate the Contrast Threshold application by either 1) closing the Contrast Threshold control panel window using its close button (red button in the upper left corner), 2) closing the Matlab window using its close button, or 3) making Matlab quit using Quit in the File Menu (or the keyboard equivalent, command-Q). With any approach, you will be asked whether you are sure you want to quit. Any unsaved data will be irretrievably lost when you quit.



**Running the Contrast Increment Task**

The stimulus display will appear as a dark gray window on the right half of the monitor. The control panel will appear to the left. You should familiarize yourself with the control panel and run some test trials before you start collecting data in earnest. You can clear any test data before you start any real data collection.

There are 5 different base contrasts: 3%, 6%, 12%, 24% and 48%. When the application runs, it uses only one base contrast at a time: the one selected with the **Base Contrast** menu (see below). It is a good idea to practice first with the highest base contrast. Once you press the **Start** button, the task will continue presenting successive trials of that **Base Contrast** until you stop it or you reach the number of stimulus repetitions selected in the control panel (**Repeats Before Stop**). “Repeats” is the number of times that each increment of the base contrast has been presented. It is a good idea to set the **Repeats Before Stop** to 5 repeats of each of the contrast increments, and cycle to a different **Base Contrast** after those 25 trial finish**.** You will need to increase the value in the **Repeats Before Stop** field (e.g., to 10)to continue collecting data once you have completed the number of repeats for a given **Base Contrast**.

For each **Base Contrast,** 5 different pre-defined and fixed contrast increments will be presented: the base contrast will be multiplied by small values ranging up to a factor of 2. The approximate multipliers are 1.0625, 1.125, sd, 1.5 or 2.0. (The actual multipliers have been adjusted slightly to overcome limitations of the video display and ensure that each requested increment contrast produces a stimulus that differs from other contrast increments.) For example, on each trial using a 48% contrast base stimulus, you might be tested with contrasts of 50.1%, 53.2%, 59.8%, 71.3% or 96.0%. The increments have been set to span detection threshold for all base contrasts. You should easily detect the largest increment, but the smallest increment will be below threshold.

At the start of each trial, a dim white fixation spot will appear, accompanied by a brief tone. You should hold your gaze on the fixation spot throughout each trial, looking away (or blinking) only between trials. Once you have fixated the spot and are ready to start a trial, you signal that you are ready by pressing the down arrow on the keyboard (while maintaining fixation). This will cause the fixation spot to turn bright white and for the two grating stimuli to appear. After the stimuli have been on the screen for the **Base Stimulus Duration** (which you should keep at 1 s), one of the two stimuli, selected at random, will increase its contrast. The change will last for only for the **Test Stimulus Duration** (which you should keep at 0.25 s), after which both grating patterns will disappear and the fixation point will turn black. You must indicate which of the two gratings increased contrast by pressing either the left or right arrow on the keyboard. There is no time limit for your response. Once you respond, you will hear a tone indicating whether your selection was correct (high tone) or incorrect (low tone). The task will then pause for the **Inter-trial Duration**, after which the next trial will start.

When doing the task, you should not let yourself get distracted by the updating data in the control panel. It is recommended that you move the panel so the data table and plot are off the bottom of the screen while you are collecting data.

Breaks: You can take a break at any time by pausing the task. It is also fine to leave the task waiting with the dim fixation spot on the screen. If you stop the task running partway through a trial, that trial will be discarded and re-tested when you begin again.

You should save your data set (**Save** Data) periodically while you work. A data set can be re-loaded (**Load Data**), but the loaded data will over-write (not combine with) any existing data.

**Tips for Getting Good Data:**

• Practice running the task with high and low base contrasts before you start collecting data

• Take frequent breaks

• Do not do trials for each base contrast all at once. Move to another base contrast after each ~5 repetitions. Doing the different base contrasts interleaved will reduce effects of fatigue or learning over the course of the data collection.

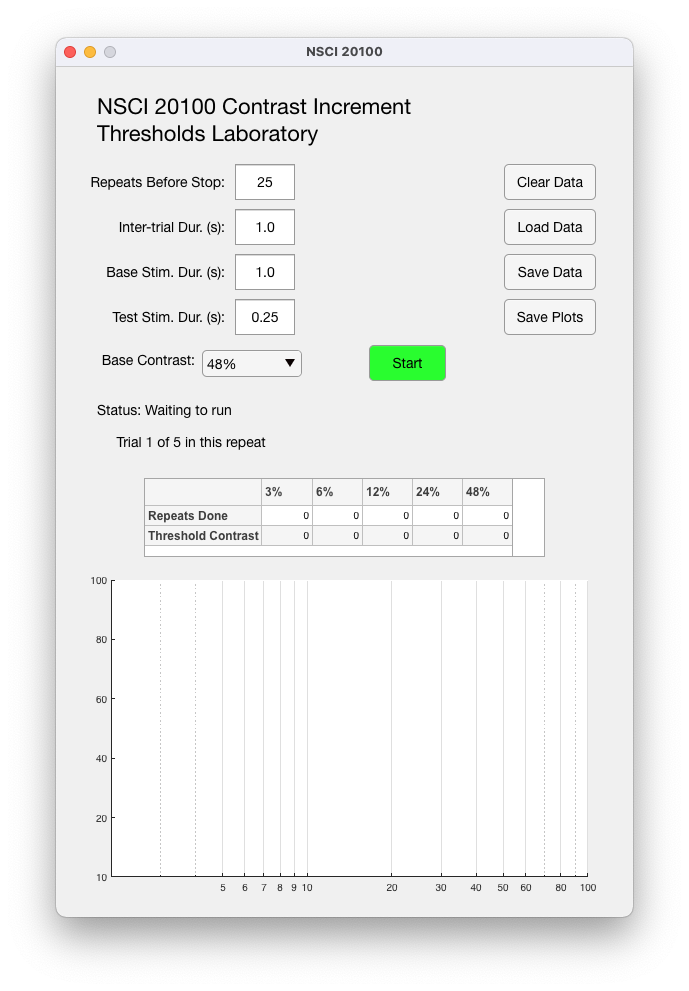
• Write down your threshold estimates after 5, 10, 15, etc. blocks. This will let you see when you start to get stable estimates and you can consider you threshold values reliable.

• Do not adjust the screen brightness or contrast or other aspects of the environmental illumination while you are collecting data. Such changes will affect the contrast thresholds you measure

• If you are unsure, do not always respond “left” or always respond “right”. You will do better and get better threshold estimates by truly guessing.

• Save your data frequently (every 5-10 minutes), so you won’t lose them if the computer loses power or crashes

• Make sure you take all the data and plots you need for your report with you when you leave the lab

**Controlling the Contrast Increment Task**

The following controls and displays are available on the Control Panel.

**Repeats Before Stop:** Number repeats of each contrast multiplier that will be done before the automatically task stops. A value of 5 will run 25 trials (5 of each of 5 multipliers for the current base contrast). Once you reach the limit, you must increase this number to collect additional data (e.g., change 5 to 10 to continue).

**Inter-trial Dur. (s):** The pause between one trial and the start of the next. You may adjust this, but you should leave enough of a pause so you are not rushed.

**Base Stim. Dur. (s):** The duration of the adapting stimulus. Leave this set to 1.0 s for all measurements.

**Test Stim. Dur. (s):** The duration of the test stimulus. Leave this set to 0.25 s for all measurements.

**Base Contrast:** Use this menu to select which of the base contrasts you will test.

**Clear Data:** Delete the data for the current base contrast (only). Any unsaved data will be irretrievably lost. If you want to clear other base contrasts, you must select each base contrast using the Base Contrast pop-up menu first and then clear its data.

**Load Data:** Load data you have previously saved. *Caution:* Loading data will overwrite all existing data. You should save any important current data before Loading Data.

**Save Data:** Save the current data set (all base contrasts) as a Matlab .mat file. Data saved in this way can be reloaded later. You should save data periodically if you must quit and relaunch the program. Note you are not expected to use the .mat file for any analysis.

**Save Plots:** Save the current contents of the control panel as an image in a PDF file.

**Start (Stop):** Toggle whether the task is running. You can also use the space bar or escape key to stop running when the control window is front-most.

**Results Table:** The first row shows the number of repetitions (repeats of each contrast multiplier) completed for each base contrast. Once a few blocks have been collected, the table will also display the estimated threshold contrast, the contrast at which performance is 75% correct. The thresholds are based on a fitted function (below).

**Performance Plot:** The performance plot shows the percent correct for each combination of base contrast and increment, all together in one plot. Increments on different base contrasts are plotted in different colors. Colored solid vertical lines mark the different base contrasts. Average percents correct are plotted with circles, and bars mark the 95% confidence intervals. Once a few blocks of data have been collected, function will be fitted to the data to estimate the contrast threshold. The fit is based on the increment data plus one equally-weighted point at 50% correct at the base contrast. The function is:

where *c* is contrast,  is the contrast increment threshold (75% correct), and  determines the steepness of the function.