Lab 0a: Introduction to Experimental Methods in Perception Research: The Oblique Effect

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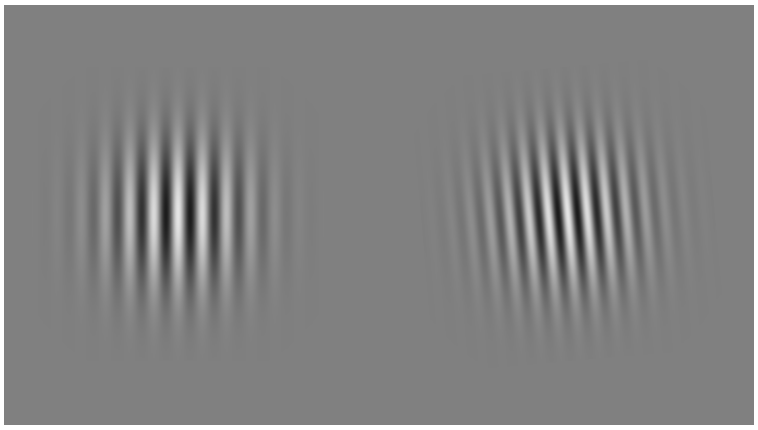

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Overview of the Experiment

Classical methods of psychophysics involve the measurement of two types of sensory thresholds: the absolute threshold, RL (Reiz Limen), the weakest stimulus that is just detectable, and the difference threshold, DL (Differenz Limen), the smallest stimulus increment away from a standard stimulus that is just detectable (also called the Just-Noticeable Difference, or JND). Gustav Theodor Fechner (1801–1887), in *Elemente der Psychophysik* (Fechner, 1860) introduced three psychophysical methods for measuring absolute and difference (JND) thresholds: the method of adjustment; the method of limits; the method of constant stimuli. In the method of constant stimuli, a standard stimulus is compared a number of times with slightly different test stimuli. When the difference between the standard and the comparison stimulus is large, the subject nearly always can correctly tell the difference between the test stimulus relative to the standard. When the difference is small, however, errors are often made. The difference threshold is the transition point between differences large enough to be easily detected and those small and difficult to detect.

The purpose of this laboratory to provide participants (you) with an introductory experience to the method of constant stimuli, and also to introduce you to the software tools that we'll be using throughout the semester (PsychoPy, R and RStudio). We will use these software tools to observe the "Oblique Effect," a well-known and reliable phenomenon in visual perception (Appelle, 1972). This effect, that perception is often better for vertical and horizontal stimulus orientations than for oblique orientations, has been studied extensively (Freeman, Brouwer, Heeger, & Merriam, 2011; McMahon & MacLeod, 2003; Meng & Qian, 2005; Nasr & Tootell, 2012; Westheimer, 2003).

Today's lab activities present the entire lifecycle of a perception experiment in a single lab session, beginning with reading a classic review paper on the Oblique Effect, using PsychoPy to perform an experiment designed to measure the Oblique Effect, and finally tabulating and analyzing data in R. Throughout this lab you will find sample text provided as a model of each of the lab competencies. You will learn to:

- Download "Lab Tools" folders from the class website and run scripts in PsychoPy and R.
- Upload csv data files to Canvas
- Visualize and analyze data in R
- Generate a lab report using R Markdown in RStudio and upload it to Canvas

Download *Lab 0a Tools* from the course website

1. In a web browser, navigate to the course webpage through Canvas or directly;
2. Download *Lab 0a Tools.zip* from the course main page, Lab section
3. Unzip the *Lab 0a Tools.zip* by double-clicking the file (on the Mac it will be automatically unzipped).
4. Move the *Lab 0a Tools* folder to your desktop so you know where it is!

PROTIP: Keep all your working files in the Lab 0a Tools folder on the Desktop: that way you won't overlook a crucial file when you save your folder before you logout!

Look at Appelle Paper

Stuart Appelle (1972) wrote an influential paper and coined the term "oblique effect", the subject of the experiment you are about to do. A pdf file of this paper is included in the Lab 0a Tools folder. Double click on the file to open it. Take five minutes to read the Abstract and the the first couple of paragraphs of the Introduction section of the paper to give you an idea of what the oblique effect is. Later you should read the whole paper. When you have finished with the Abstract and parts of the Introduction proceed to the next section to run the experiment.

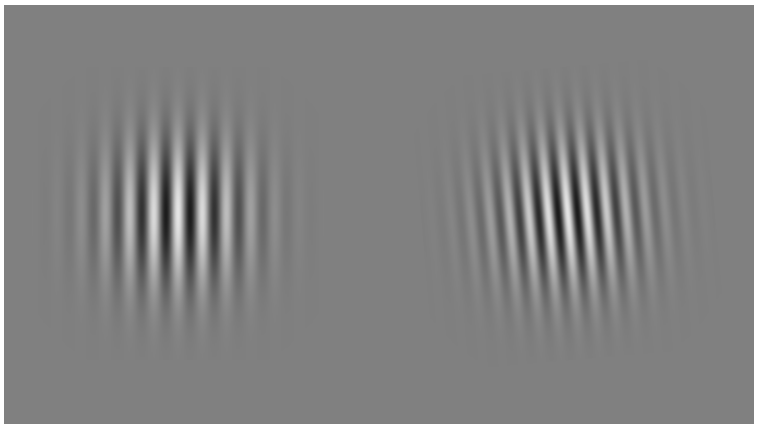

Figure 1: Examples of two Gabor patches used as stimuli. The patches were present one at a time. The first patch, the standard, has vertical strips (left panel) and the second patch, the test, has strips rotated either to the left (counter-clockwise) or to the right (clockwise). Can you perceive which way the test strips are rotated?

Instructions for the Experiment

You will be shown two visual patterns with black and white strips (called a Gabor Patch). The first stimulus, the standard stimulus, had vertical strips (0 degree orientation) followed by a second stimulus, the test stimulus, whose orientation was tilted to the left (counter-clockwise) or to the right (clockwise) relative to the standard. The subject had to judge which way the test stimulus was tilted, left or right. The amount of tilt of the test was varied from trial to trial and varied from very small (and thus difficult to perceive) to rather large (and thus easy to perceive). Figure 1 illustrates a vertical standard stimulus (left panel) and a slightly tilted test stimulus (right panel). Which way is the test stimulus tilted?

The experiment will be run under computer control using PsychoPy, a popular program written in Python by Jonathan Peirce, at the University of Nottingham, England (Peirce, 2007, 2009). PsychoPy allows you to run experiments with carefully controlled visual and auditory stimuli and to collect response data and reaction times. You'll need to download, then run the experiment file.

Launch the PsychoPy Application

Navigate to the *Orientation JND Experiment* folder. Locate the *Orientation_JND.psyexp* file and double-click on it. The application PsychoPy2 should launch and a window should open. If it does not, find PsychoPy in the Applications folder and double click on it, then use Open to open the *Orientation_JND.psyexp* file. It should look exactly like Figure 2.

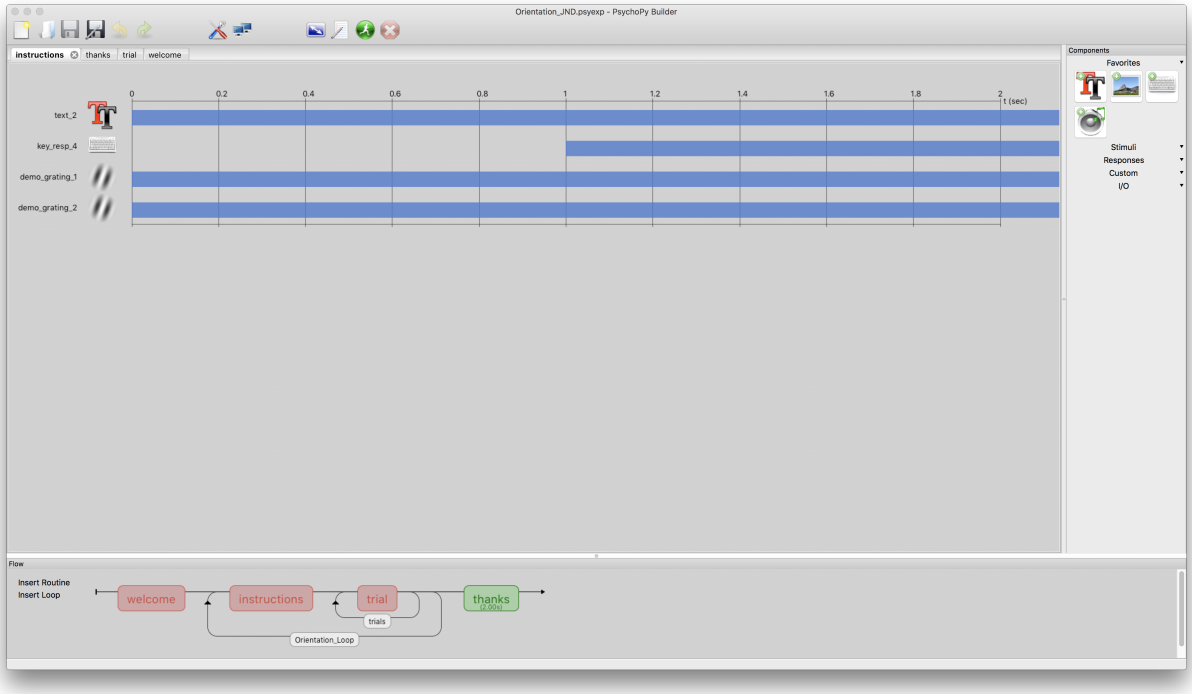

Figure 2: The flow of this PsychoPy experiment. Each box at the bottom is a routine. Each strip at the top is an event that happens during a routine.

Run the Experiment

1. Run the experiment by clicking on the green button with the runner in white.
2. You will be shown the "info dialog," as shown in Figure 3.
3. Enter your own initials in the observer field
4. Verify that the value 10 is in the repeats field. This number tells PsychoPy how many blocks of trials to run.
5. Click OK to begin the experiment.

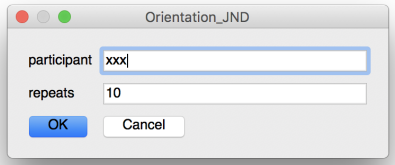

Figure 3: The PsychoPy Information Dialog Box that pops up at the beginning of the experiment. The information entered here will be included in the data file. Later you will learn how to add more information if you need to.

Follow on screen instructions to do the experiment. Consider setting the number of repeats to 1 or 2 and running the experiment as a practice session. Then change repeats to 10 and run the complete experiment. The program will run two blocks of 90 trials: one block with the standard orientation set to 0 deg (vertical strips) and the other block with the standard orientation set to 45 deg (oblique strips).

On each trial you will first be presented with the standard stimulus (either 0 or 45 deg, depending on the condition) followed by a test stimulus. The test will be rotated slightly counterclockwise or clockwise relative to the standard. You must judge which by pressing the left arrow key (if you think the second stimulus is counterclockwise) or the right arrow key (if you think it was clockwise). On each trial the computer will record your responses. Some of the judgments will be easy and some will be difficult. The whole experiment should not take more than 30 minutes. Figure 1 shows two examples of Gabor patches: the one on the left is oriented at 0.0 degrees (vertical) and the other is tilted clockwise by 2.0 degrees. Can you see the difference?

Your experimental data will be automatically saved in the data folder in a text file whose name starts with your initials with the date and time added to it. The file extension is csv (comma-separated values). After the experiment has finished you can double click on the file to open in Excel. Do not modify this data file. It represents a lot of judgments and work on your part.

Using a web browser, log onto Canvas at https://canvas.colorado.edu, and upload your data csv file to the lab0a csv data dropbox in Assignments under Lab Individual Data Files (upload csv data files). If you ran a practice run or two before running the proper experiment, only upload the final (latest) csv data file to Canvas. This file will contain all your data. The other files are incomplete and don't need to be saved. But don't delete anything to make sure you don't accidently delete a critical and irreplaceable file!

Analyze Your Data

We will now guide you through an analysis of your data. Take a break to wait for our presentation.

Now that you have uploaded your own csv data file to Canvas it is time to take a look at them. We have prepared an R script written in R Markdown format that shows you how to integrate R code along with text (this document you are reading was prepared with R Markdown). In your `Lab_0a_Tools_Fall_2018` folder you will see a file named `Lab0a_Individual_Data_Analysis.Rmd`. The Rmd extension on the file means it is an R Markdown file. Double click on this file to launch RStudio. The file contents will appear in the upper left pane of the RStudio window, where you can edit it to your heart's content.

Take a look at this document. You will see text that is written in the areas with white background. This text will appear (with some formatting) in your final pdf document. You will also see chunks of gray areas containing R code. These code chunk are evaluated in order and the output, if any, are included in your final document. The code in this script, especially the code that produces graphs is quite complicated. Don't be intimidated. By the end of the semester you will be able to produce complex graphs using your own R code! For now, all we want you to do is run this code and it will analyze your data from the experiment you just did. The results of this analysis are quite thorough and detailed, with a lot more information than you would typically include in a journal article or even a lab report. We want you to see the power of R and RStudio to produce elegant documents from your data.

There are only two things you should change near the top of this file. They are

1. On line three insert you own name instead of the "Your name here".
2. You need to tell the script where it can find your csv data file. It is located in the data folder of the PsychoPy experiment folder. This location is already specified on line 24 of the code, in the variable called `additional_files_path`, so do not change it. On line 27 there is a variable called my_csv_file which is set to be a file (`LOH...`) that does not exist on your computer. Change this file name to be the file name of your csv data file, the one that you uploaded to Canvas and the one that is in the data folder. Don't edit anything else in this file.

Now you can select the `Run All` command from the `Run` tab of the edit pane; it is at the top on the right side. If all goes well RStudio will execute the R code in each of the code chunks in sequence and any output produced by the code will appear below the chunk. Scroll down the the file until you find graphs. We will walk you through this process and explain what it all means.

If all the code is working you are ready to produce a beautifully formatted pdf document that you can (should) upload to the assignment section Canvas. Just clik n the `Knit` tab at the top left of the edit pane. RStudio will then that you text, your code and its output and create a pdf file for your enjoyment. Be sure to upload this pdf file to the Assignement Lab 0a folder in Canvas.

Complete Lab Report

Next week we will show you how to produce a complete lab report using R and R Markdown with RStudio. This report will include the title page, short abstract, introduction, methods, results, discussion and reference sections that make up a standard American Psychological Association (APA) journal article. Check out the *Sample APA Manuscript (Guide)* that is posted on the course website:

http://psych.colorado.edu/~lharvey/P4165/P4165_2018_3_Fall/Main_Page_2018_Fall_PSYC4165.html

You will use the APA journal article format for the four remaining lab reports during the semester. Next week we will provide you with the results of every person in the class (anonomized of course) and guide you through an analysis of these group data for inclusion in the final lab report. Next week you will learn our standard way of analyzing group data: visualize, fit linear mixed-effects statistical models and compute bootstrap estimates of effect sizes.

Congratulations

You have been exposed to a lot of new material today. If you feel overwhelmed, hang in there. By the end of the semester you will feel at home with all of this material as hard as this is to believe now. Sam and I are here to help you so ask questions when you don't understand the material.

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