In Lab 3b, you will analyze the self-paced reading data that you collected in Lab 3a. The ‘SPR440’ study that you ran contained 136 sentence items from a number of different sub-experiments. In this lab, you’re going to focus on two of those sub-experiments. This lab will assume that you are using Microsoft Excel for analysis, although you are welcome to use any similar kind of program (contact me if you need the data in a different format). Note that different versions of Excel have slightly different menu options, so don’t freak out if the screenshot in the lab is not identical to yours. If you can’t figure out how to do something in your version, let us know.

The first experiment you’ll look at is essentially a replication of the same design that Traxler & Pickering (1996) and Omaki & Schulz (2011) used to examine whether comprehenders use incremental, ‘active’ processing in comprehending filler-gap ‘movement’ dependencies and whether this processing is initially faithful to the competence grammar. There were 4 conditions across 28 items, so that each participant saw 7 items of each condition type. The conditions were the following:

**BasicImplausible:** The city that the author wrote regularly about was named for an explorer.
**BasicPlausible:** The book that the author wrote regularly about was named for an explorer.
**IslandImplausible:** The city that the author who wrote regularly saw was named for an explorer.
**IslandPlausible:** The book that the author who wrote regularly saw was named for an explorer.

The second experiment you’ll look at is a novel paradigm which follows up work by Wagers, Lau, & Phillips (2009) on agreement attraction in comprehension. Wagers et al. observed that even though comprehenders usually slow down when they read an agreement error (singular subject-plural verb), they slowed down less when there was a plural attractor in the sentence. The second experiment uses a similar paradigm, but it examines coordinate phrases as compared to morphologically plural attractors. The conditions were the following:

**SgAttGr:** The slogan about the husband was designed to get attention.
**SgAttUngr:** The slogan about the husband were designed to get attention.
**PlAttGr:** The slogan about the husbands was designed to get attention.
**PlAttUngr:** The slogan about the husbands were designed to get attention.
**CoordAttGr:** The slogan about the husband and wife was designed to get attention.
**CoordAttUngr:** The slogan about the husband and wife were designed to get attention.
**Preliminaries: Data structure and Pivot Tables**

This section will give you an understanding of how the data is structured and how to use the Pivot Table tool, for doing the rest of the lab. If you happen to already know how to use Pivot Tables, you may be able to skip some of this part.

1. Open ‘all_class_data_wh.xlsx’ in Microsoft Excel.

2. To understand the structure of the datafile, we should think about the experimental task, and what data was recorded during the experiment. In the experiment, participants read one sentence at a time. Individual words in the sentences were masked, and participants pressed the spacebar to reveal one word at a time. Every time they pressed the spacebar, the computer recorded their reaction time (how long it took them to press it). So, for every word in every sentence that a participant saw, we have a RT number. We also get an RT for their response to the question at the end of the sentence. Each individual RT recording gets its own line in our datafile.

So, for every subject in the experiment, there are \( n \) lines of data, which is calculated by the equation below. \( S \) is the number of sentences a subject saw, and \( R \) is the number of regions per sentence.

\[
    n = S \times R
\]

So, the datafile you have in front of you is just a series of individual recordings (RTs), tagged with information about where it comes from. Information is stored in the columns:

- ‘subjNum’ == This column specifies the subject that the data was collected from.
- ‘Experiment’ == Identifier for the sub-experiment
- ‘itemNum’ == a numeric code for each sentence item
- ‘condition’ == which experimental condition the sentence was from
- ‘wordPos’ == the position of the word in the sentence (or ? for question response)
- ‘word’ == the word presented or the button response (Y or N)
- ‘reg’ == the region within the sentence that the RT corresponds to
- ‘RT’ == the amount of time spent leading up to the button-press

In this ‘long’ format, it is very hard to see any structure in the data, right? But Excel has a magical tool called ‘PivotTables’ which we are going to be using to do most of this lab assignment.

3. Creating a PivotTable:
   - Make sure your cursor is on some cell that has data in it.
   - Select “Data > PivotTable …” from the menu bar.
- Specify the range of data you want to use. Excel will often specify all of the relevant data by default.

- Here or in the next step, you’ll need to decide where to place the PivotTable. It’s a good rule to always place it in a new worksheet to avoid confusion. It’s often a good idea to rename that worksheet later so you can keep everything straight.
- Now you need to select the layout of your PivotTable. In older versions of Excel, you need to press the ‘Layout’ button that will appear after you press ‘Next’ on the earlier window. In newer versions of Excel, the empty data frame and PivotTable options window will pop up automatically.

Choosing the layout is a critical step which you will be messing around with a lot in this lab, so you should get familiar with this step. In the “Field name” box of the PivotTable window, there should be a list corresponding to the column names from the datafile. You can now drag-and-drop these menu items into the appropriate position to create your desired tables. The three choices are, what will the columns be, what will the rows be, and what will the actual values be that you put in the table.

In this lab, you’re basically always going to be interested in reaction time measures, so you will always be dragging ‘RT’ into the box labeled ‘Values’ or ‘Data’, depending on your version of Excel. Most of the time you will be interested in looking at different kinds
of RT averages, so you need to make sure that you change from the usual default of ‘Sum’ or ‘Count’ to ‘Average’. You can do this by double-clicking on ‘RT’ in older versions of Excel or just by clicking on the Values subfield in new versions of Word.

Most of the interesting choices will be in what you decide for your rows and columns. For example, let’s say I wanted to create a table that showed me the average RT of words in a sentence by condition. I would just drag “condition” into my “ROW” subfield in the PivotTable Menu, and “RT” into my “VALUES” subfield. If I wanted the average RT by condition and item, I might drag ‘condition’ into my “COLUMN” subfield and ‘item’ into my “ROW” subfield.

Now you know how to create pivot tables!
Part 1: Filler-gap Experiment

1. If you closed it, re-open ‘all_class_data_wh.xlsx’.

2. As a first order of business, before looking at our contrasts of interest, let’s take a moment to consider the between-subject variability in our data. Create a pivot table that displays average RTs for each subject. Include a screenshot of this table. Are there any values that seem drastically different from the others? Why might this be? Is this a concern?

3. Similarly, create a pivot table for average RT for each item and include a screenshot. What does this show us? Are there any values that seem drastically different from the others? Why might this be?

4. So far we have been averaging RTs across all the words in all the sentences to get a birds-eye view of the data. Now, before we go on, take a minute to think about this experiment by answering the following questions. There are at least two separate questions that this experiment is addressing. What are they? What region(s) of the sentence are going to be critical for answering these questions, if we break the sentences up as indicated below? What conditions are we comparing between, and what pattern of RTs would you expect to see, based on previous studies?

Basic Conditions:

<table>
<thead>
<tr>
<th>The</th>
<th>city/book</th>
<th>that</th>
<th>the</th>
<th>author</th>
<th>wrote</th>
<th>regularly</th>
<th>about</th>
<th>was</th>
<th>named</th>
<th>for</th>
</tr>
</thead>
<tbody>
<tr>
<td>a1</td>
<td>b1</td>
<td>c1</td>
<td>d1</td>
<td>e1</td>
<td>g1</td>
<td>h1</td>
<td>i1</td>
<td>j1</td>
<td>k1</td>
<td>k2</td>
</tr>
</tbody>
</table>

Island Conditions:

<table>
<thead>
<tr>
<th>The</th>
<th>city/book</th>
<th>that</th>
<th>the</th>
<th>author</th>
<th>who</th>
<th>wrote</th>
<th>regularly</th>
<th>about</th>
<th>was</th>
<th>named</th>
<th>for</th>
</tr>
</thead>
<tbody>
<tr>
<td>a1</td>
<td>b1</td>
<td>c1</td>
<td>d1</td>
<td>e1</td>
<td>f1</td>
<td>g1</td>
<td>h1</td>
<td>i1</td>
<td>j1</td>
<td>k1</td>
<td>k2</td>
</tr>
</tbody>
</table>

5. Now create a CONDITION x REGION pivot table, so that we can look at the by-region RTs between each conditions (hint: use the ‘column’ as well as the ‘row’ for a cleaner table). Why do you think some values appear to be missing? What do ‘regions’ 0 and 1 represent?

6. Now you will plot the RTs across regions. Since the basic items have a different number of words than the island items, we can do a separate plot for each. Copy the
data from the pivot table to the area below such that you have two mini-tables, one for the basic condition and one for the island condition. Don’t include the ‘Grand Totals’. Also, delete the 0 and 1 regions since they are not informative. Now, for each mini-table, select the table and select the line graph option from the Chart menu to plot the data.

Resulting tables:

Add a title to each of the two charts if you can, and adjust the y-axis on both such that they are the same (you may start the y axis at a number greater than 0 if you prefer). Include a screenshot of your plots. Look at the data values in the table and the plots. Do you observe the predicted pattern of results in the basic conditions? What about the island conditions? Why or why not? How does this address the experimental questions you highlighted above?

7. Sometimes just a couple extreme data points—outliers—can have an outsize effect on your data. Go back to the full data sheet (Sheet1), click anywhere in the data, and go to Data -> Sort, to sort by RT.
Scroll all the way to the bottom to look at the longest RTs—on the order of 5-13 seconds. Most of them are responses to questions, but there are some button presses to sentences mixed in. Can you imagine any possible explanation for these extreme RTs?

8. As a rule of thumb for this lab, we'll say that anything above 3 seconds on a word is likely to reflect unnatural reading, so delete these rows. Now go back to your pivottable sheet, right-click on the pivottable, and select ‘Refresh Data’. Copy a new pair of mini-tables from the new pivottable, and create a new pair of plots. Include a screenshot. How did the plots change based on excluding these outlier data points? Does this change your interpretation of the results?

9. Do the results of the class exactly replicate previous results? Why or why not? Can you imagine any ways of improving this experiment?
Part 2: Agreement Experiment

Open ‘all_class_data_agreement.xlsx’. Here is a map to the region labels. Note that in this experiment only the regions immediately before and after the critical verb are coded.

All Conditions:

<table>
<thead>
<tr>
<th>The</th>
<th>advice</th>
<th>from</th>
<th>The</th>
<th>doctor(s)/doctor and nurse</th>
<th>was</th>
<th>reasonable</th>
<th>but</th>
<th>the</th>
<th>patient...</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>v-2</td>
<td>v-1</td>
<td>v</td>
<td>v+1</td>
<td>v+2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

11. Again, before we go on to do the analysis, take a minute to think about this experiment by answering the following questions. Based on the conditions, what question is this experiment addressing? What are two possible hypotheses about this question? What region numbers of the sentence are going to be critical for answering this question—will this be different for different conditions? What conditions are we comparing between, and what pattern of RTs would you expect on either hypothesis?

12. Following the instructions above, sort by RT and exclude values greater than 3000ms. Now follow the same instructions as given above to create a region x condition pivottable for the agreement data.

To visualize the data, critically you will want to make three separate plots. This is because the three different attractor conditions each have different words before the critical region, so this could cause differences in RT that have nothing to do with the critical verb. So you will want one plot for SgAtt conditions, one plot for PIAtt conditions, and one plot for CoordAtt conditions.

As you did above, add a title to each of the three charts if you can, and **adjust the y-axis such that they are the same on all three plots.** Include a screenshot of your
plots. Look at the data values in the table and the plots. What pattern do you observe in the results? What does this suggest? How does this address the experimental questions you highlighted above?

13. Do you think these results are surprising or not? Can you imagine any ways of improving this experiment, or informative follow-up experiments that could be run?