Open Science

In this assignments, you will define a theoretical hypothesis, translate it into a statistical hypothesis, design a study to test your hypothesis, collect the data, report the results, create a reproducible analysis file, and publically share the data, the analysis file, and the research report online. Learning these Open Science practices will allow you to share all aspects of your research with others. To keep the research project in this assignment feasible, the data collection will consist of movie ratings on the IMDB. You can come up with any hypothesis you want, as long as we can test it based on the IMDB ratings of movies! This assignment will be peer-reviewed by fellow students. All the aspects that need to be included in the final assignment are indicated in **bold**.

Let's start by defining a **theoretical hypothesis**. My favorite movie of all time is Fight Club. It stars Brad Pitt and Edward Norton. My theoretical hypothesis is that Brad Pitt and Edward Norton are both great actors, and because they are both great, the movies they play in are equally good. You can pick any hypothesis you like. For example, sequels to movies will have lower IMDB ratings than the original movie, movies with the word 'Bad' in them have lower ratings than movies with the word 'Good' in them, or Marvel superhero movies are better than DC superhero movies. Be as creative as you want.

Q1) Write down your **theoretical hypothesis**.

IMDB will provide both the IMDB rating, and the metascore (provided by metacritic.com). Which will you use? Or do you predict an effect on both DV's? I'll just focus on the IMDB scores. We need to explain in more detail which datapoints we will collect. Will we randomly sample X movies from all the hits our IMDB search will give? Sort our search results based on the release date, and use the X most recent movies? In my case, I will use the X last movies Edward Norton and Brad Pitt starred in from today, the moment I did the IMDB search.

Q2) Write down which **dependent variables** you will measure.

Justify your sample size. I predict no difference, and thus I'll do a power analysis for an equivalence test (see Assignment 6). I want to be pretty sure I can reject my smallest effect size of interest, so I'll design a study with 90% power. For this educational assignment, I do not expect you to collect a huge amount of data. As long as I can exclude a large effect

(Cohen's *d* = 0.8 or larger) I'll be happy for this assignment. The power analysis estimates that the sample size we need to show the difference between the ratings for movies starring Edward Norton and Brad Pitt is smaller than Cohen's *d* = 0.8 (assuming the true effect size is 0, and with an alpha of 0.05, when I aim for 90% power) is 34 movie ratings from Brad Pitt, and 34 movie ratings from Edward Norton. Obviously, your sample size justification might be based on accuracy, or feasibility (e.g., the amount of time you have) – any justification can be valid.

Note: Normally we would choose to collect as much data as possible, and it's quite easy to get the movie ratings for all movies Edward Norton and Brad Pitt starred in. However, copying numbers from a website into a spreadsheet is not the most educational part of this assignment. If this was real research, we would collect as much data as possible, but for this assignment, don't overdo the data collection. Spend your time on learning other skills than copy-pasting.

Q3) **Justify your sample size**. Which alpha level do you find acceptable? Is your test one-sided or two-sided? Will you use sequential analyses, and adjust your alpha level? Which power do you want? Which effect size do you expect? Or how accurately do you want to estimate the effect? Or what number of observations is feasible to collect, given your time and resources?

We need to translate our theoretical hypothesis to a statistical hypothesis. Which statistical test will you do? I will calculate the 90% CI around the effect size. When the 90% CI falls below, and excludes a Cohen's *d* of 0.8, I will consider the movie ratings of Edward Norton and Brad Pitt as equivalent.

Q4) **Specify the statistical test you will conduct**. Specify relevant parameters (such as the alpha level you will use, the *r* scale for the Bayes Factor, etc.).

In other research, you might need to think of more things, such additional analyses you want to do, how you will correct for multiple comparisons, or how you will deal with outliers, or what you will do if the assumptions of the test are violated. But for now, this is enough.

Congratulations! By answering questions Q1 to Q4 you have completed the pre-registration of your study. Let's make it formal.

Pre-registering your research

Go to https://aspredicted.org/ and create a new AsPredicted pre-registration:

Create a new AsPredicted pre-registration CREATE

Click the 'create' button. Fill in your name, e-mail, and institution.

Participating Authors (Up to 5)

First Name:	Last Name:	Email:	University/Institution:
Daniel	Lakens	D.Lakens@tue.nl	Eindhoven University of Technology

Scroll down, and answer questions 1 to 9. At 2) paste your answer to Q1, at 3) paste your answer to Q2, at 4) explain how many groups you will compare (e.g., 2, Edward Norton vs. Brad Pitt), at 5) enter the answer at Q4, and at 7) enter the answer from Q3. Answer the remaining questions, and preview your pre-registration:

PREVIEW

hit 'pre-register'. If everything looks OK, hit the 'SUBMIT' button.

To make any changes click BACK, otherwise:

SUBMIT

Then, you need to approve the submission (and if you had co-authors, they would also need to approve the submission). Click the link:

Don't forget that you also need to approve the submission, which you can do here

Click the button to see your new pre-registration:

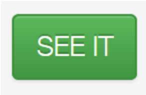
SEE IT

And click APPROVE

Recall: Approved pre-registrations remain private until a participating author acts to make it public

APPROVE REJECT

And click OK for the pop-up indicating this can not be undone. We will make the pre-registration public. If you do research, you don't have to make your pre-registrations public immediately, but in this assignment, we will do so. Once again, click:



Scroll down, and click:

Click OK on the pop-up warning you that this can not be undone.

Now you can download the .pdf file with your pre-registration:

A .pdf containing the AsPredicted *'v' (#1037)* is now publicly available here: https://AsPredicted.org/6wfnq.pdf

Download the pdf file and save it – you have to share it as part of this assignment.

Collecting Data

Now that we have pre-registered our hypothesis let's collect some data. Use the normal IMDB search to find the movies you want, or the advanced search functions.

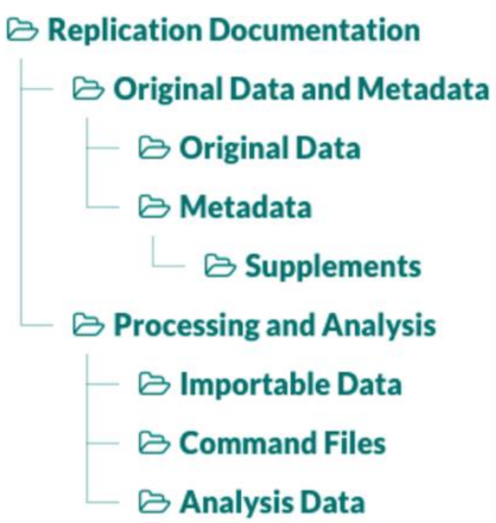
I searched for movies starring Brad Pitt as an actor, order based on release data, and the same for Edward Norton.

You can type in your data in any software you want to use – a spreadsheet, a statistical software package, or even just in a text file. This will be your **original data file**. I used a spreadsheet file.

It turns out that Edward Norton has acted in 32 movies, so we are 2 movies short of our planned sample size of 34 movies. That happens, there is nothing we can do about it, so we will just describe this in the research report.

We will use the TIER documentation protocol to keep our files organized, and store the data in a way that will allow me to understand our own data in the future, or allow other people to reproduce the data analysis. We will then share this data on the Open Science Framework, a website that allows you to store your research data, and whenever you are ready to do so, make this data public and accessible for other researchers. You can check my example of this assignment on the Open Science Framework here.

You can download the folder structure you need in a zip file, and unzip the folder structure to your working directory for this research project. It should look like this:



Place your original data in the 'Original Data' folder. It will remain here, unchanged, so we always have a version of the original dataset. In the meta-data folder, include a document that contains information about

1) A citation to the website from which you downloaded the data.
2) The data you downloaded, and a description of how others can access this data (e.g., the search terms you used).
3) Some information that will allow readers to understand the original data. This information should be similar to a 'codebook'. In our simple datafile, this will be straightforward, but in larger datasets, this requires careful work.
4) If you use existing datasets, a DOI (Digital Object Identifier) assigned to the dataset, if available. This is not needed for our project.

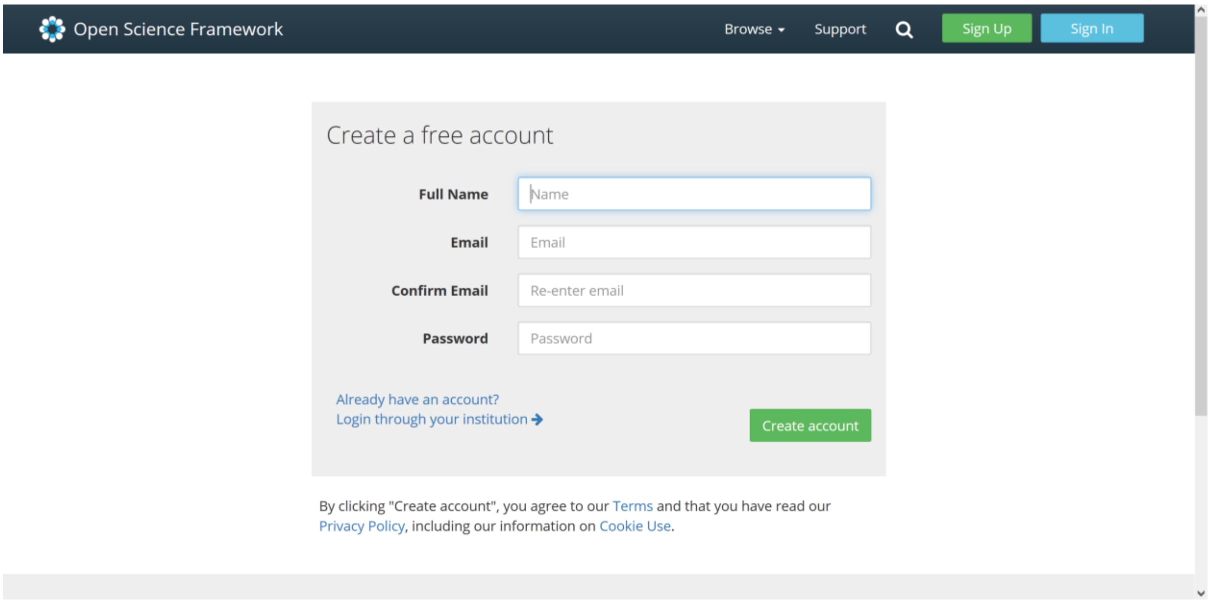
In the 'Importable Data' folder, **store a copy of your data that can be used by the statistical software you are using**. For example, it is often easiest to import a comma separated value document into a statistics program. If you have entered the data in a spreadsheet, you might want to store that data in a .csv file, and place the .csv file in the 'Importable Data' folder. Maybe you directly typed in the data in your statistical software. In this case, the importable data file is a copy of the original data.

The next step is to analyze your data. Try to follow your pre-registered analysis plan. If you realize you need to make change to your original plan, note these changes while writing up the results. You can do Frequentists tests, Bayesian tests, or both. The most important thing here is to create an analysis script, that can be directly run on the importable data file, and that will exactly reproduce the analyses you will report in the Research Report. For example, do not just point and click in SPSS, but paste the syntax for each analysis you perform. Make sure it is annotated (i.e., you add an explanation of what the code does) so that other could in principle understand which analysis in the analysis script is linked to which result in your research report. Save your **analysis file** in the 'Command File' folder.

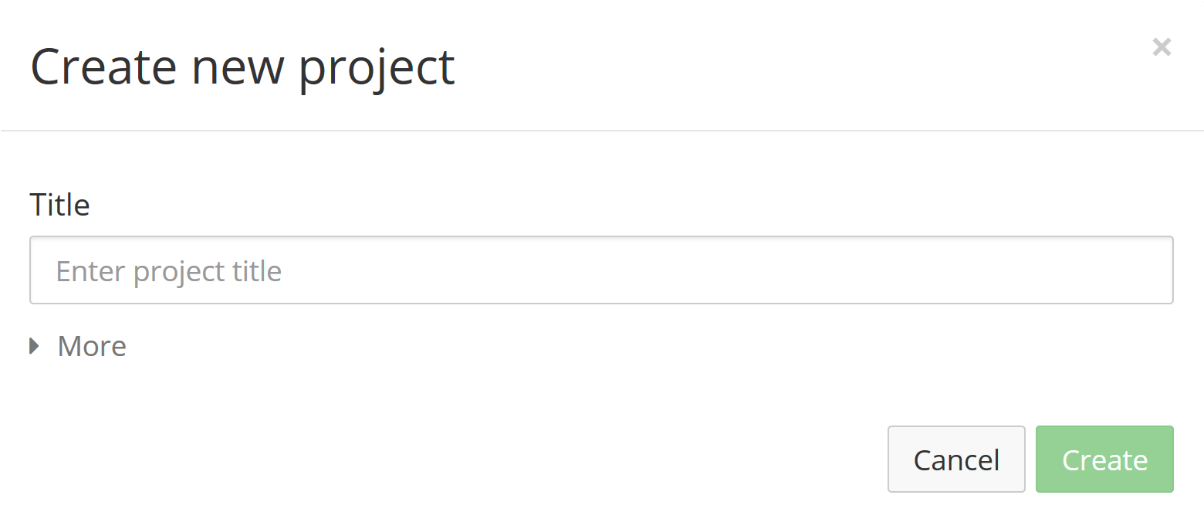
Q5) Write down the **relevant statistics in a result section**, and **don't forget to interpret the results**. There are no requirements – peer reviewers will not grade how well you did your analysis, only that you analyzed your data. Introduce the data analysis with a short explanation of your hypothesis (you can take this from your pre-registration). End the data analysis with a short, one-sentence **conclusion**. Save this document as the '**Research Report**' and place it in the top level of the 'Replication Documentation' folder.

Now you have completed your research project, let's share the results and the data! We will upload the **pre-registration, data, report, and analysis files** to the Open Science Framework (OSF). The Open Science Framework allows you to store data, materials, and analysis scripts for free, and make these files publically available whenever you are ready. You can also use the OSF to pre-register your hypothesis (which can be very useful if your pre-registration is more elaborate than the 8 questions on AsPredicted), and includes stimuli you will use, or even the analysis files you will use).

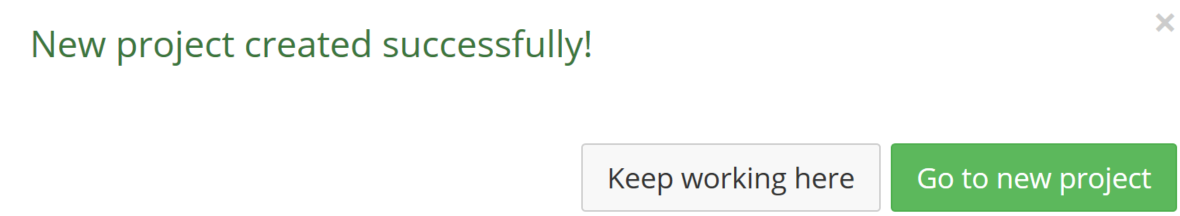
Create a (free) account on the Open Science Framework.



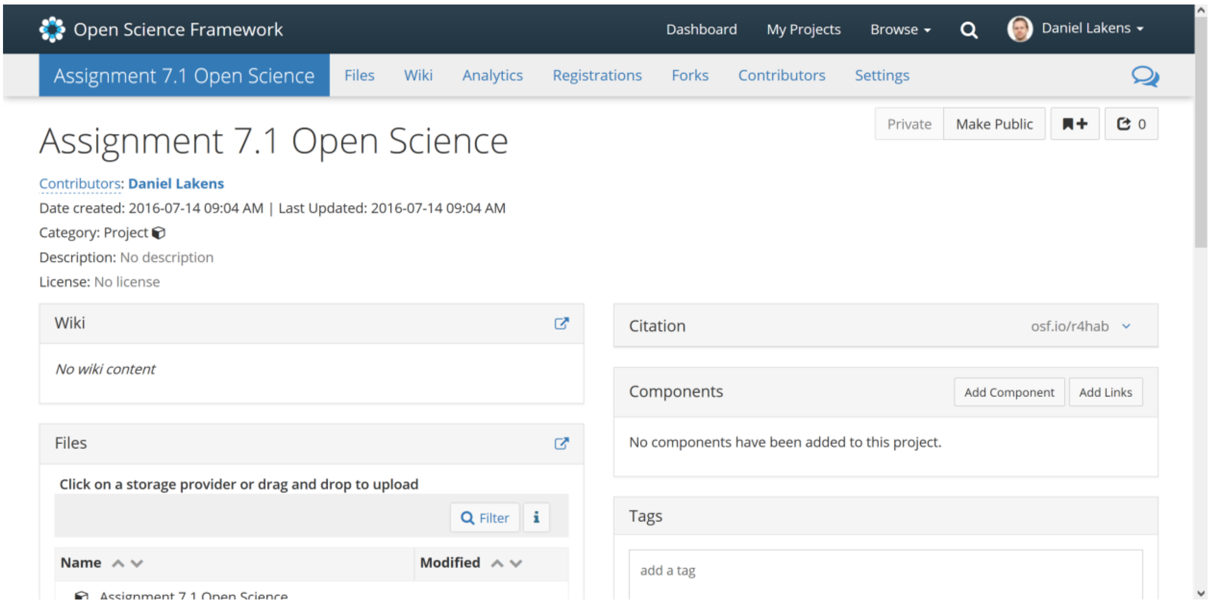
Then create a new project:



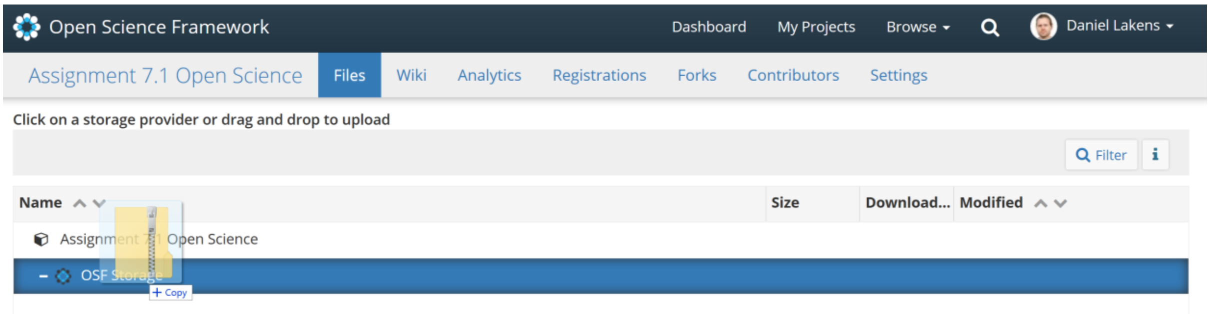
As a title, enter anything you will remember, for example Assignment 7.1 Open Science. Click ‘create’ and then ‘Go to new project’.



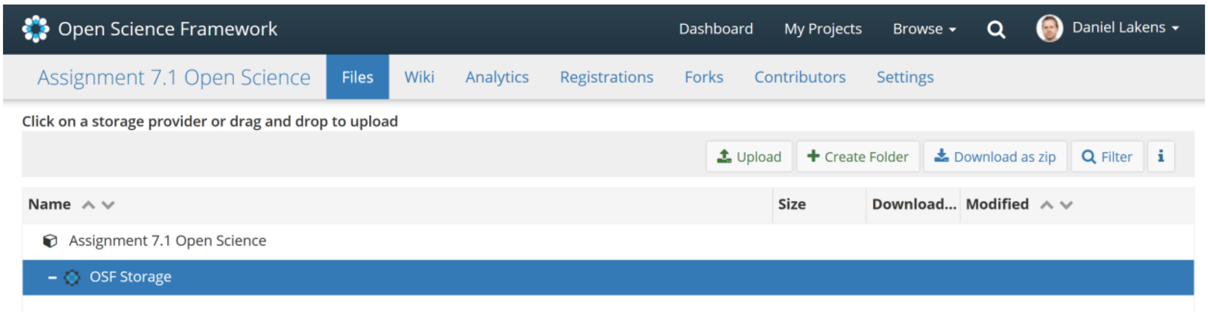
You will see your new project page:



Click on the ‘Files’ tab. You can upload files to the OSF. There are two options. You can either zip the Replication Document folder, and upload a single .zip file, or you can recreate the folder structure on the OSF. That's what I'll do, even though it is a bit more work, but it will allow people to preview all the files on the OSF. To upload the zip file, just drag the zipped folder from your computer to the browser, and drop it onto the OSF Storage line, as shown in the picture below.

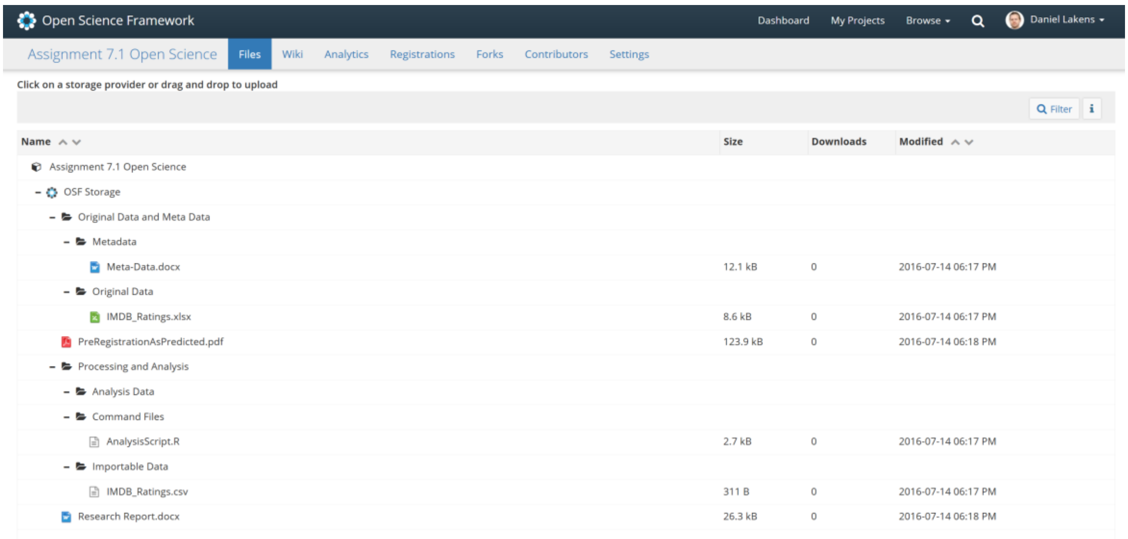


Alternatively, you can recreate the folder structure. Click on the 'OSF Storage' line. Buttons will appear that allow you to +Create Folder. See below.



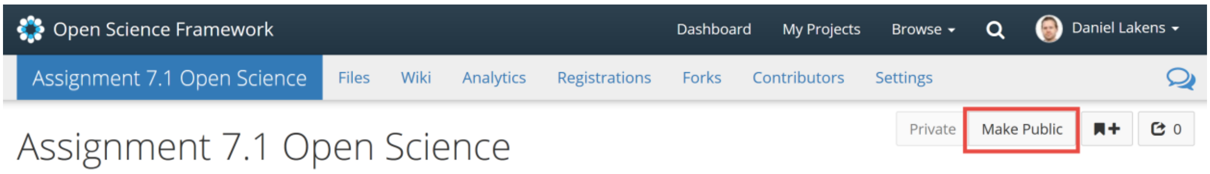
Upload the **original data, the importable data, the analysis files, the research report, and the pre-registration**. You can, but don't have to, upload a meta-data document and a codebook. Uploading these in real research is important, but they are not the most important learning objective in this assignment.

The final result should look like the screenshot below:

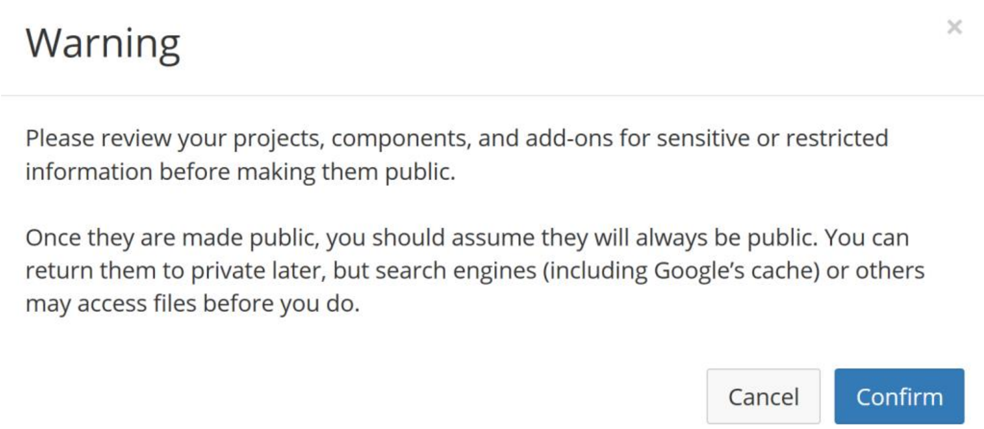


Go back to the main page of your OSF project by clicking on the name of your project in the top left of the screen. **The final thing that we need to do is make it possible for others to access our files by making the project page public**. By default, the project is private, and you can use the OSF to privately store your research data. But you can also make the page public, whenever you are ready. **If the page is not public, fellow students can't peer review it!**

Click the 'Make Public' button (highlighted by the red square in the picture below)



You will get a warning that you need to make sure there is no confidential information that is being shared, and that making data public can't be undone.



Click 'Confirm'. Your research project is now publically available. My example for this assignment is available here: https://osf.io/r4hab/.

Q6) As an answer to this assignment, share the link to your publically accessible project page on the Open Science Framework. The files on the Open Science Framework page will be peer-reviewed by fellow students. If you followed all steps in this assignments, you will receive a 'pass' grade.