Plan for Ziwei, Summer Neuroscience Program (SNP), June 3 – July 26:

Week 1 (June 3 – June 7):

Learning Goals:

- Describe the question, hypothesis, background, and design of the fMRI study
- Identify and summarize what fMRI is measuring and standard analyses for fMRI
- Apply coding skills to determine the design details of the fMRI study
- Summarize the background literature related to the proposed fMRI study
- Synthesize your readings into a draft of your SNP poster

- Because of the differences in PsychoPy versions, take Yu-Chin's task in full on the testing room computer. This will show you what the experiment was like for a participant, which you will need to know in terms of thinking about the design and how you would explain this work to other researchers
    - When finishing taking the study, apply your skills from having coded in PsychoPy to extract out relevant details from her study. For example, how many trials were there? What was the length between the presentation of a stimulus and the next trial? Etc.
- Read relevant research, with an eye towards fMRI analysis, critical analysis of the researchers' findings (limitations, etc.), thoughts about what you would like to study in graduate school, and how all this will impact the MRI analysis for this study:
  Topics covered: context reinstatement, fMRI, LWPC, precued LWPC, audio-visual Stroop, recognition memory in relation to cognitive control
    - Bornstein, A. M., & Norman, K. A. (2017). Reinstated episodic context guides sampling-based decisions for reward. *Nature Neuroscience*, *20*(7), 997. https://doi.org/10.1038/nn.4573
    - Gershman, S. J., Schapiro, A. C., Hupbach, A., & Norman, K. A. (2013). Neural Context Reinstatement Predicts Memory Misattribution. *Journal of Neuroscience*, *33*(20), 8590–8595. https://doi.org/10.1523/JNEUROSCI.0096-13.2013
    - Baldassano, C., Chen, J., Zadbood, A., Pillow, J. W., Hasson, U., & Norman, K. A. (2017). Discovering Event Structure in Continuous Narrative Perception and Memory. *Neuron*, *95*(3), 709-721.e5. https://doi.org/10.1016/j.neuron.2017.06.041
    - Bugg, J. M., & Dey, A. (2018). When stimulus-driven control settings compete: On the dominance of categories as cues for control. *Journal of Experimental Psychology: Human Perception and Performance*. https://doi.org/10.1037/xhp0000580
    - Bugg, J. M., & Diede, N. T. (2017). The effects of awareness and secondary task demands on Stroop performance in the pre-cued lists paradigm. *Acta Psychologica*. https://doi.org/10.1016/j.actpsy.2016.12.013
    - Bugg, J. M., & Smallwood, A. (2016). The next trial will be conflicting! Effects of explicit congruency pre-cues on cognitive control. *Psychological Research*, *80*(1), 16–33. https://doi.org/10.1007/s00426-014-0638-5
    - Bugg, J. M., Diede, N. T., Cohen-Shikora, E. R., & Selmeczy, D. (2015). Expectations and experience: Dissociable bases for cognitive control? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*(5), 1349–1373. https://doi.org/10.1037/xlm0000106
    - Hutchison, K. A., Bugg, J. M., Lim, Y. B., & Olsen, M. R. (2016). Congruency precues moderate item-specific proportion congruency effects. *Attention, Perception, & Psychophysics*, *78*(4), 1087–1103. https://doi.org/10.3758/s13414-016-1066-y
    - Gonthier, C., Braver, T. S., & Bugg, J. M. (2016). Dissociating proactive and reactive control in the Stroop task. *Memory & Cognition*, *44*(5), 778–788. https://doi.org/10.3758/s13421-016-0591-1

    - Bugg, J. M., & Chanani, S. (2011). List-wide control is not entirely elusive: Evidence from picture–word Stroop. *Psychonomic Bulletin & Review*, *18*(5), 930–936. https://doi.org/10.3758/s13423-011-0112-y
    - Chiu, Y.-C., & Egner, T. (2019). Cortical and subcortical contributions to context-control learning. *Neuroscience & Biobehavioral Reviews*, *99*, 33–41. https://doi.org/10.1016/j.neubiorev.2019.01.019
    - Chiu, Y.-C., Jiang, J., & Egner, T. (2017). The Caudate Nucleus Mediates Learning of Stimulus–Control State Associations. *The Journal of Neuroscience*, *37*(4), 1028–1038. https://doi.org/10.1523/JNEUROSCI.0778-16.2016
    - Yu-Chin Chiu, & Tobias Egner. (2015). Inhibition-Induced Forgetting: When More Control Leads to Less Memory. *Psychological Science*, *26*(1), 27–38. https://doi.org/10.1177/0956797614553945
    - Donohue, S. E., Liotti, M., Perez, R., & Woldorff, M. G. (2012). Is conflict monitoring supramodal? Spatiotemporal dynamics of cognitive control processes in an auditory Stroop task. *Cognitive, Affective, & Behavioral Neuroscience*, *12*(1), 1–15.
- Revisit what you have learned in your fMRI class and write out a) what fMRI is; b) what each step in fMRI analysis is; c) what different fMRI analyses are and what each does – what questions do these analyses answer? What are the assumptions underlying each analysis? What analyses do you think that we will be doing for this project?
- Start making your poster for the SNP poster session:
    - You will want to check with Tyler Lee or Paige Cooper about the dimensions of the poster – last I heard, it was either 42" x 42" or 42" x 54".
    - This will involve synthesizing the research you read that was crucial for the MRI study's design into the background and study description. It will also involve making a figure that accurately explains the study design, which will help when you're actually writing up your thesis too. Finally, you should get familiarity with different programs that people use to design posters, including Photoshop, InDesign, Powerpoint, and more, and think about how you want to lay out the information for your study.
    - You obviously won't fill *in* the results sections yet, but because you will have spent time thinking about fMRI and the type of analysis we will do for this project, you can have rough headlines for each analysis.
    - Your "Designing Effective Academic Posters" isn't until July 9th, but we can talk about effective posters ahead of time, and when you get to that class time, you'll start thinking more about the revision process for your poster (i.e., you're making a draft early on, so you're not stressed about it later).
- Write out your own goals for the summer and consider how to fit them into this preordained schedule. Mark deadlines for the program and discuss with Christina about how they fit into the schedule.
- It is not necessary to finish everything that is laid out by each week; this is a tentative schedule. If your work overlaps with the next week, that is fine too. Don't feel like these week by week guidelines are set in stone.
    - Especially since every Tuesday is basically taken up by SNP classes

Week 2 (June 10 – June 14):

Learning Goals:

- Discover how the principles of open science apply to fMRI analysis
- Describe the differences between fMRI analysis programs

- Identify different components of FSL as an analysis program
- Apply coding skills to prepare the behavioral data for fMRI analysis

- Open science principles: how can they be applied to fMRI?
    - First refresh yourself on what open science principles mean. I left these readings in your Zotero, but I don't know if you actually ended up reading these.
        - *Open Science Collaboration 2015.pdf*. (n.d.).
        - *Gilbert et al. 2016.pdf*. (n.d.).
        - *Spellman 2015.pdf*. (n.d.).
    - Next, research what "BIDS" format means, and reflect on how you would want to implement that for this project
- How do different fMRI analysis programs handle fMRI analysis?
    - Research the different types of fMRI analysis programs. How do they differ? What are the strengths and weaknesses of each?
    - The goal here is that if you're going into a graduate school program to do fMRI or neuroscience research, you recognize what the different programs are. You have some experience thinking about EEG and ERPs from your class and the presentation in lab meeting. Now, you should have an idea for *why* we're doing analysis in FSL and why in your graduate career, you might pick another program.
- Familiarize yourself with fMRIPrep
    - What does their pipeline involve? What is each step of preprocessing that they are doing? What does each preprocessing step involve? What are the different options that you can choose from? What do each of these options mean/do? Why would you want to choose one option over the over?
    - You might also want to take a peak at their code: do you understand what they're doing in each step? You might want to research writing bash scripts or in linux online as well, since that's what a lot of the MRI analysis coding is.
    - Esteban, O., Markiewicz, C. J., Blair, R. W., Moodie, C. A., Isik, A. I., Erramuzpe, A., … Gorgolewski, K. J. (2018). fMRIPrep: a robust preprocessing pipeline for functional MRI. *Nature Methods*, 1. https://doi.org/10.1038/s41592-018-0235-4
- Familiarize yourself with FSL
    - If it's not already installed on your computer, you will need to install a Virtual Machine – see https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FslInstallation. You won't be able to do any of the analysis on your own computer and must use a lab computer.
    - Once installed, familiarize yourself with each of the auxiliary programs attached to FSL. For instance, what is the primary function of FSLeyes? What can you do in FSLeyes? There are lectures, videos, and practicals for the different programs here: https://fsl.fmrib.ox.ac.uk/fslcourse/. This will help you contextualize what you think about the fMRIPrep steps.
- Familiarize yourself with the behavioral data for the fMRI study:
    - How is each csv file structured? What measures did we collect and might we analyze? I may give you a csv of all the participants together.
        - Apply your coding skills to write a script that analyzes the behavioral data based off what you have learned about the task design.
        - You will want to include behavioral graphs on your poster.

    - Write a script for each participant that creates a text file with categorized trials: for each trial type, for each subject, have the onset of the trial in one column, the duration of the trial in the next column, and all ones in the next column. This is what's typically called a "timing file" and will let the analysis program know what timepoints correspond to each condition of analysis.

Week 3 (June 17 – June 21):

- You've now had some experience thinking about preprocessing and analysis within FSL by familiarizing yourself with fMRIprep and FSL as well as other fMRI analysis programs. Now, we want to decide what each preprocessing step we will take. What do you recommend we do based on your readings?
- In the fall, you will be busy with other courses, writing applications for graduate school, and contacting PIs to let them know that you're interested in their lab, among other work within Egner lab. Therefore, to save you some time later and to prepare ahead, I want you to outline your Introduction for your thesis. This means synthesizing all that you now know about the question, hypothesis, design, and analysis for the fMRI study into writing, as many papers will also preview what the study did in the Introduction. It means developing your science communication skills, and applying what you learned about the background readings to paper.

Week 4 (June 24 – June 28):

- We will largely follow the guidelines established by BIAC on fMRI analysis within FSL (https://wiki.biac.duke.edu/biac:fsl).

Week 5 (July 1 – July 5):
Week 6 (July 8 – July 12):
Week 7 (July 15 – July 19):
Week 8 (July 22 – July 26):

Misc:

- Think about your own goals for the summer, especially as they pertain to research (e.g., graduate school, coding)
- You mentioned wanting to take the GRE again; you could start studying for this in the summer and retake the test in the fall
- You mentioned wanting to learn more about reinforcement learning and coding; you can also take coding courses in the summer that will help develop these skills