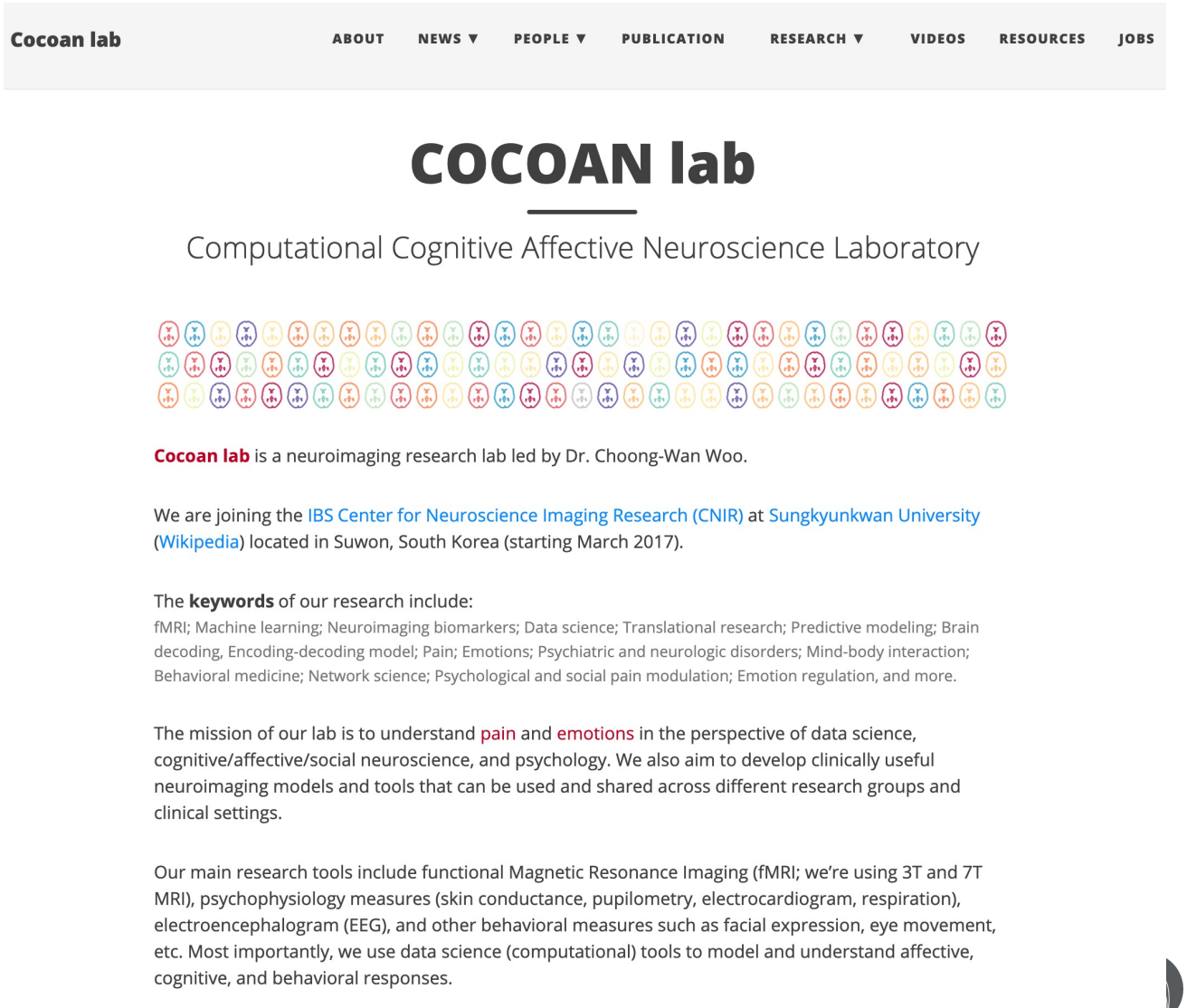
Lecture 01
Class overview

Introduction

Lab webpage

https://cocoanlab.github.io/



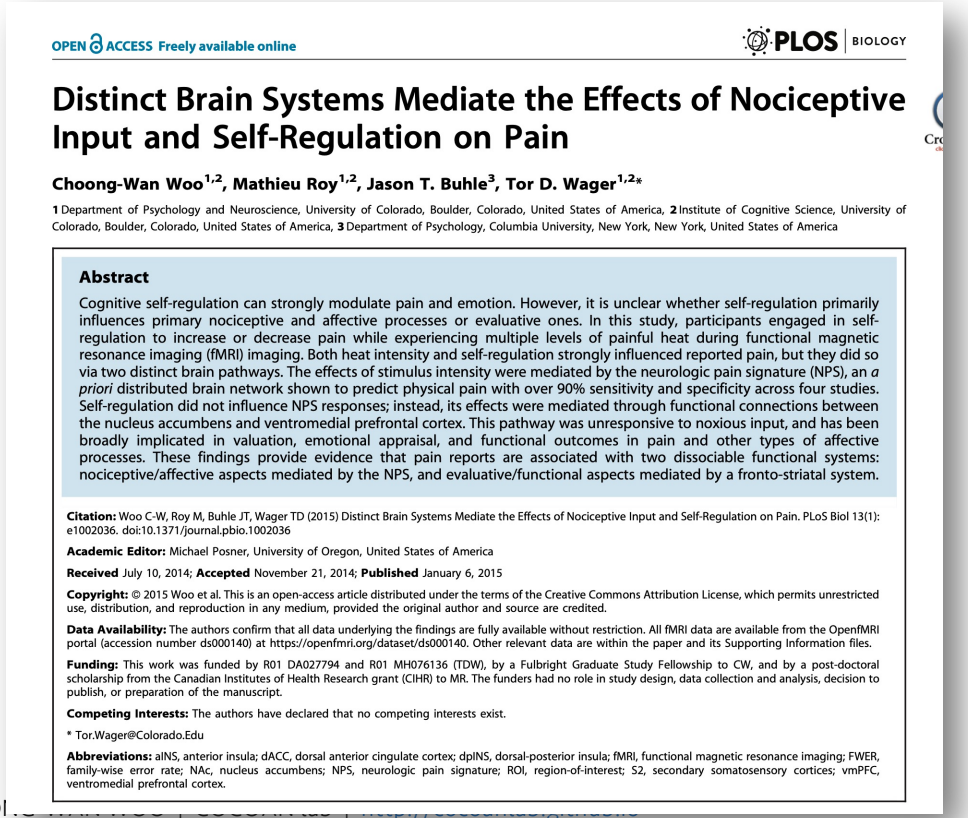
Course overview

- Biostats and Big data… and this is the Biostats and Big data II
- Class code: GBE 3072
- Room: Computer room (86103) at N-center 1st floor

- "Biostats and Big data" focuses on the "conceptual" aspects of basic statistics
- "Biostats and Big data II" will focus more on the "hands-on" aspects of basic statistics
  - We will learn basic statistics frequently used in research papers
  - We will learn how to read the results, how to run the analyses, and how to report the results
  - 3R: Read, Run, and Report – this is the learning goal of this course

3R: Read, Run, Report

- We will start with these two papers!
- Similar tasks, paradigms… I will explain the details of the papers next week, but let's take a brief look!



OPEN ACCESS Freely available online

PLOS | BIOLOGY

Distinct Brain Systems Mediate the Effects of Nociceptive Input and Self-Regulation on Pain

Choong-Wan Woo[1,2], Mathieu Roy[1,2], Jason T. Buhle[3], Tor D. Wager[1,2]*

1 Department of Psychology and Neuroscience, University of Colorado, Boulder, Colorado, United States of America, **2** Institute of Cognitive Science, University of Colorado, Boulder, Colorado, United States of America, **3** Department of Psychology, Columbia University, New York, New York, United States of America

Abstract

Cognitive self-regulation can strongly modulate pain and emotion. However, it is unclear whether self-regulation primarily influences primary nociceptive and affective processes or evaluative ones. In this study, participants engaged in self-regulation to increase or decrease pain while experiencing multiple levels of painful heat during functional magnetic resonance imaging (fMRI) imaging. Both heat intensity and self-regulation strongly influenced reported pain, but they did so via two distinct brain pathways. The effects of stimulus intensity were mediated by the neurologic pain signature (NPS), an *a priori* distributed brain network shown to predict physical pain with over 90% sensitivity and specificity across four studies. Self-regulation did not influence NPS responses; instead, its effects were mediated through functional connections between the nucleus accumbens and ventromedial prefrontal cortex. This pathway was unresponsive to noxious input, and has been broadly implicated in valuation, emotional appraisal, and functional outcomes in pain and other types of affective processes. These findings provide evidence that pain reports are associated with two dissociable functional systems: nociceptive/affective aspects mediated by the NPS, and evaluative/functional aspects mediated by a fronto-striatal system.

Citation: Woo C-W, Roy M, Buhle JT, Wager TD (2015) Distinct Brain Systems Mediate the Effects of Nociceptive Input and Self-Regulation on Pain. PLoS Biol 13(1): e1002036. doi:10.1371/journal.pbio.1002036

Academic Editor: Michael Posner, University of Oregon, United States of America

Received July 10, 2014; **Accepted** November 21, 2014; **Published** January 6, 2015

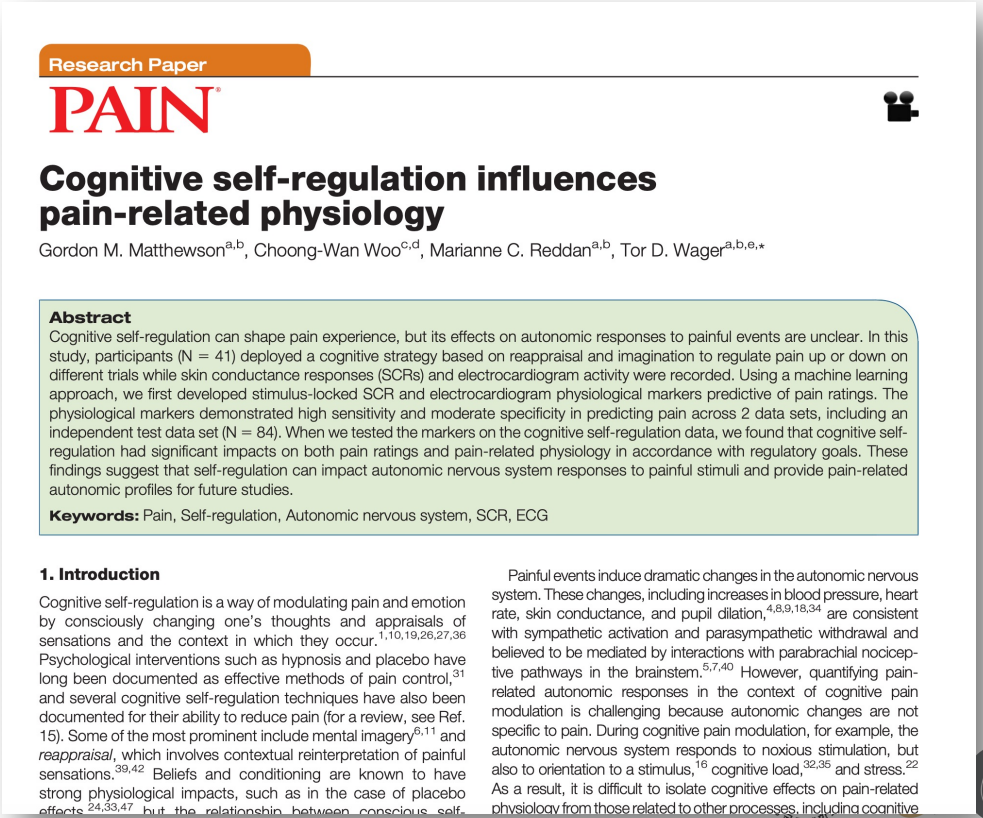
Data Availability: The authors confirm that all data underlying the findings are fully available without restriction. All fMRI data are available from the OpenfMRI portal (accession number ds000140) at https://openfmri.org/dataset/ds000140. Other relevant data are within the paper and its Supporting Information files.

Funding: This work was funded by R01 DA027794 and R01 MH076136 (TDW), by a Fulbright Graduate Study Fellowship to CW, and by a post-doctoral scholarship from the Canadian Institutes of Health Research grant (CIHR) to MR. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

* Tor.Wager@Colorado.Edu

Abbreviations: aINS, anterior insula; dACC, dorsal anterior cingulate cortex; dpINS, dorsal-posterior insula; fMRI, functional magnetic resonance imaging; FWER, family-wise error rate; NAc, nucleus accumbens; NPS, neurologic pain signature; ROI, region-of-interest; S2, secondary somatosensory cortices; vmPFC, ventromedial prefrontal cortex.



Research Paper

PAIN

Cognitive self-regulation influences pain-related physiology

Gordon M. Matthewson[a,b], Choong-Wan Woo[c,d], Marianne C. Reddan[a,b], Tor D. Wager[a,b,e,*]

Abstract

Cognitive self-regulation can shape pain experience, but its effects on autonomic responses to painful events are unclear. In this study, participants (N = 41) deployed a cognitive strategy based on reappraisal and imagination to regulate pain up or down on different trials while skin conductance responses (SCRs) and electrocardiogram activity were recorded. Using a machine learning approach, we first developed stimulus-locked SCR and electrocardiogram physiological markers predictive of pain ratings. The physiological markers demonstrated high sensitivity and moderate specificity in predicting pain across 2 data sets, including an independent test data set (N = 84). When we tested the markers on the cognitive self-regulation data, we found that cognitive self-regulation had significant impacts on both pain ratings and pain-related physiology in accordance with regulatory goals. These findings suggest that self-regulation can impact autonomic nervous system responses to painful stimuli and provide pain-related autonomic profiles for future studies.

Keywords: Pain, Self-regulation, Autonomic nervous system, SCR, ECG

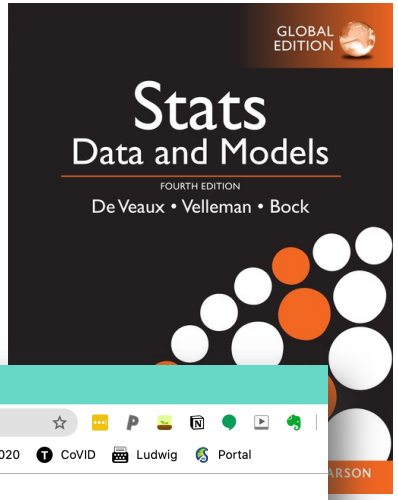
1. Introduction

Cognitive self-regulation is a way of modulating pain and emotion by consciously changing one's thoughts and appraisals of sensations and the context in which they occur.[1,10,19,26,27,36] Psychological interventions such as hypnosis and placebo have long been documented as effective methods of pain control,[31] and several cognitive self-regulation techniques have also been documented for their ability to reduce pain (for a review, see Ref. 15). Some of the most prominent include mental imagery[6,11] and *reappraisal*, which involves contextual reinterpretation of painful sensations.[39,42] Beliefs and conditioning are known to have strong physiological impacts, such as in the case of placebo effects.[24,33,47] but the relationship between conscious self-

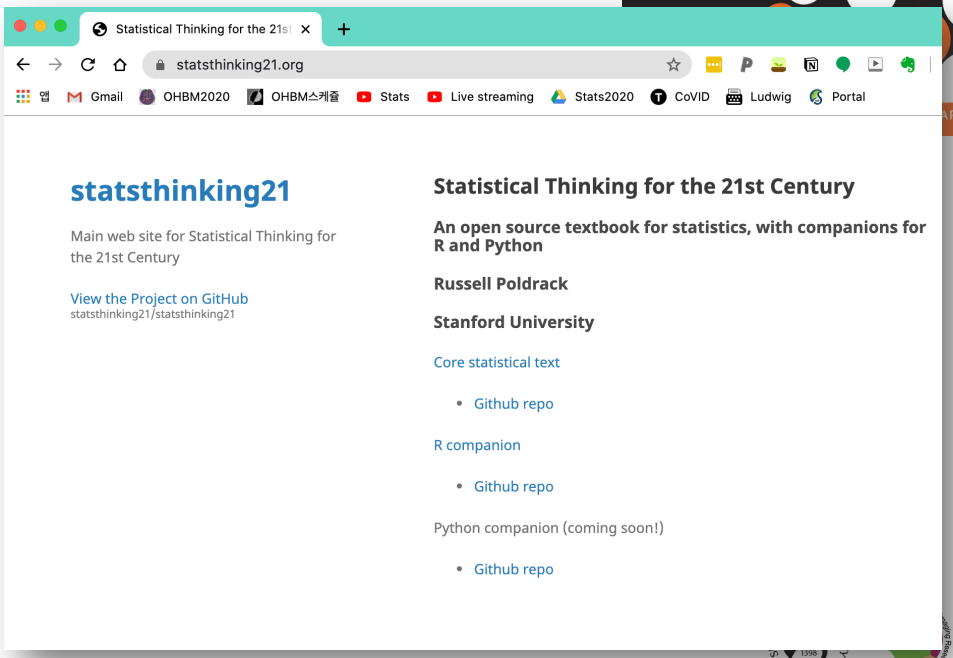
Painful events induce dramatic changes in the autonomic nervous system. These changes, including increases in blood pressure, heart rate, skin conductance, and pupil dilation,[4,8,9,18,34] are consistent with sympathetic activation and parasympathetic withdrawal and believed to be mediated by interactions with parabrachial nociceptive pathways in the brainstem.[5,7,40] However, quantifying pain-related autonomic responses in the context of cognitive pain modulation is challenging because autonomic changes are not specific to pain. During cognitive pain modulation, for example, the autonomic nervous system responds to noxious stimulation, but also to orientation to a stimulus,[16] cognitive load,[32,35] and stress.[22] As a result, it is difficult to isolate cognitive effects on pain-related physiology from those related to other processes, including cognitive

Textbooks

- Textbook: we will keep using the stats textbook of the “Biostats and Big data” class
  - "Stats: Data and Models" by De Veaux, Velleman, and Bock, Fourth Edition



- But we will also use “Statistical Thinking for the 21st Century” by Russell Poldrack
  - This is the online book (free!!)
  - You can also download PDF or EPUB



Web-based platforms for the class

- We will use two useful web-based platforms for the class:
  1. **Slack** for class-related discussion and questions

     https://join.slack.com/t/wanistats2fall2022/shared_invite/zt-1f1m6tbx3-2~wp6NZRhd780GU09vD6fg

  2. **GitHub** for posting class-related materials, assignments, data, codes, etc

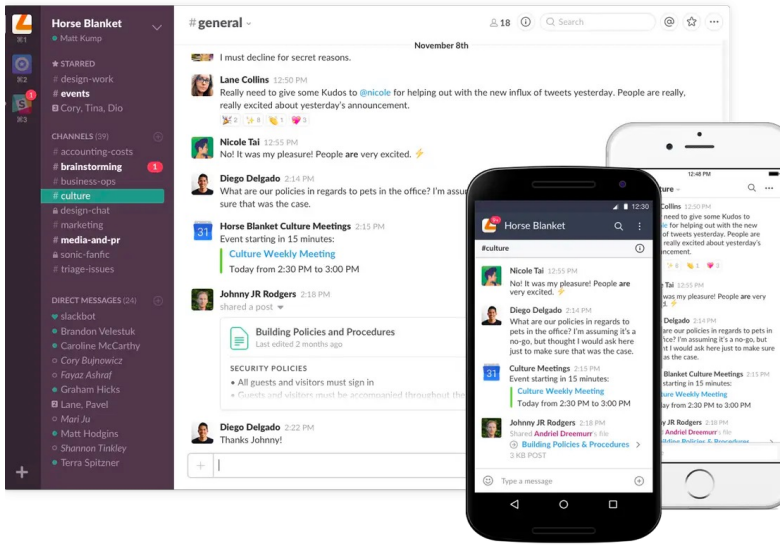
slack

- A great platform for team communications

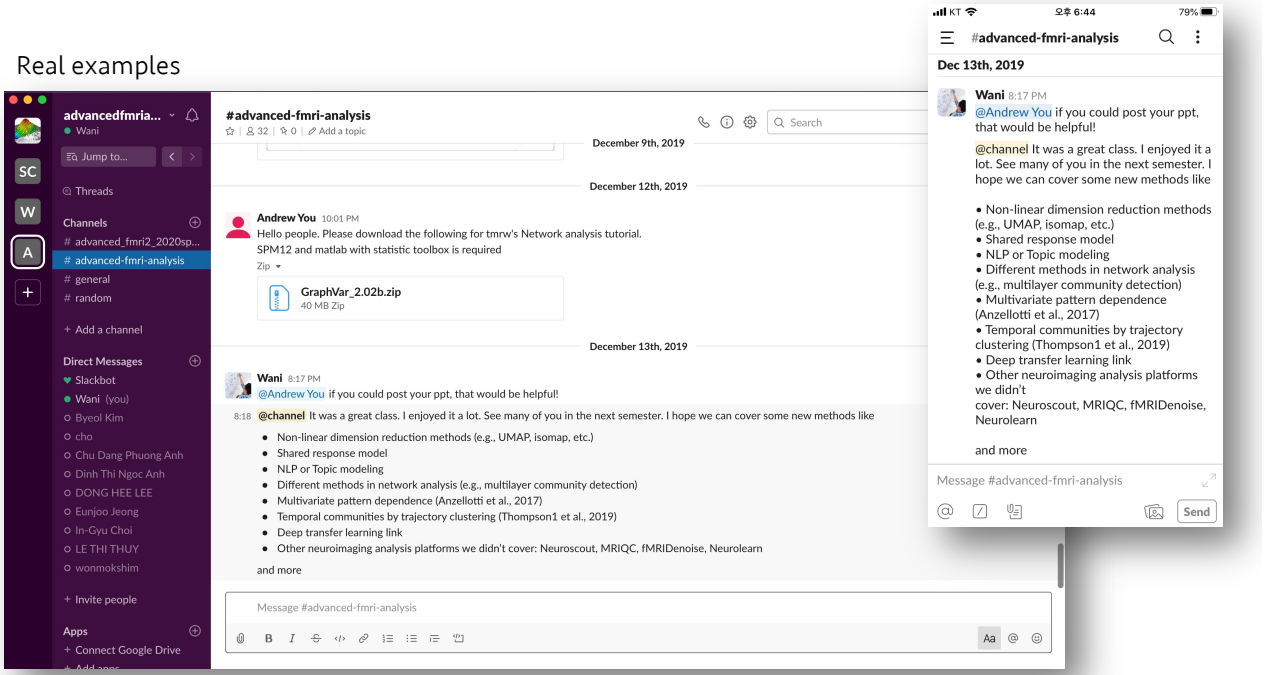
  You can sign up for the class through this link:

  https://join.slack.com/t/wanistats2fall2022/shared_invite/zt-1f1m6tbx3-2~wp6NZRhd780GU09vD6fg

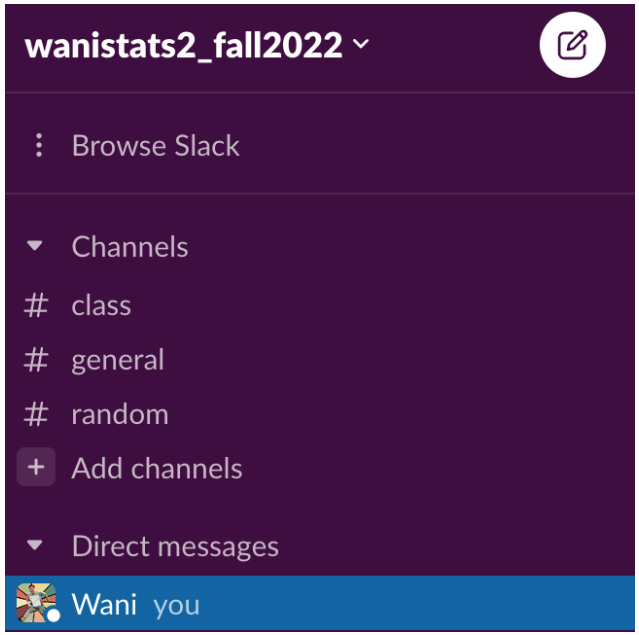
Works for both desktop and mobile phone



Real examples



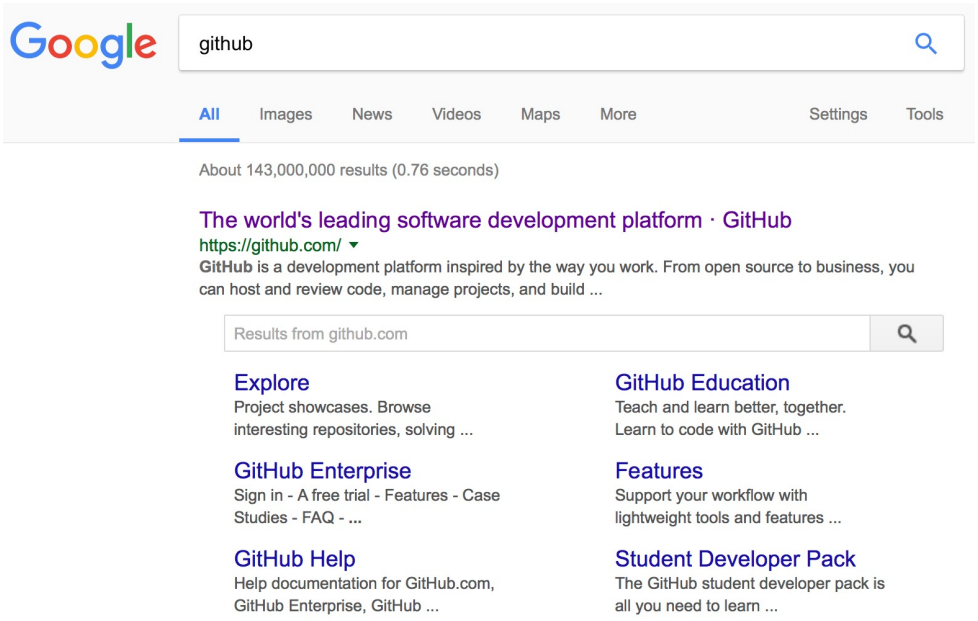
slack

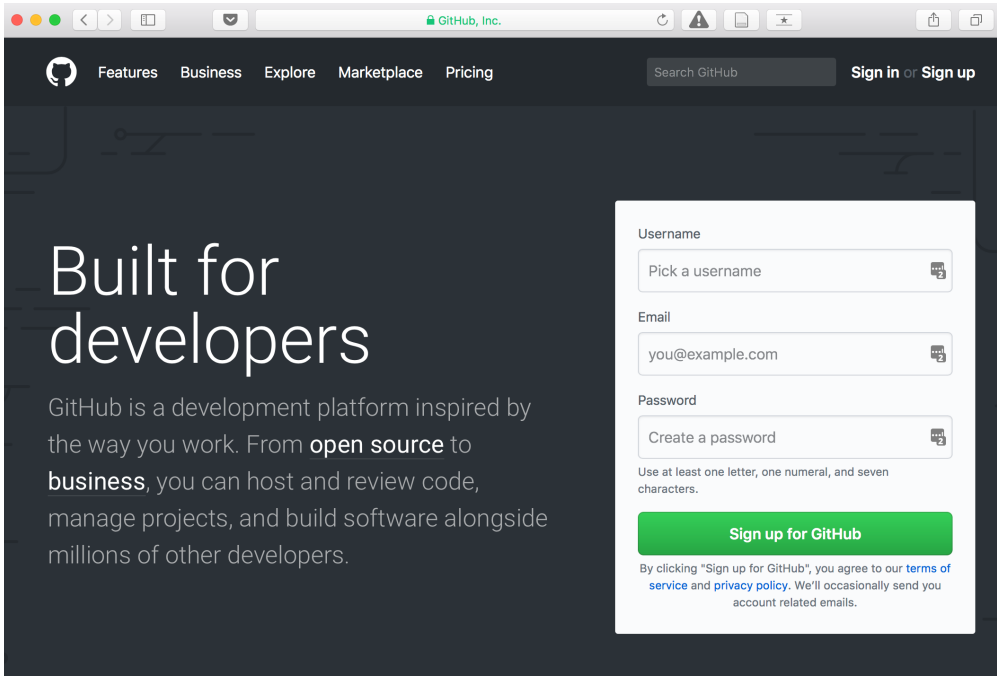


- Please use 이름_학번! (e.g., 우충완_123456789)

GitHub

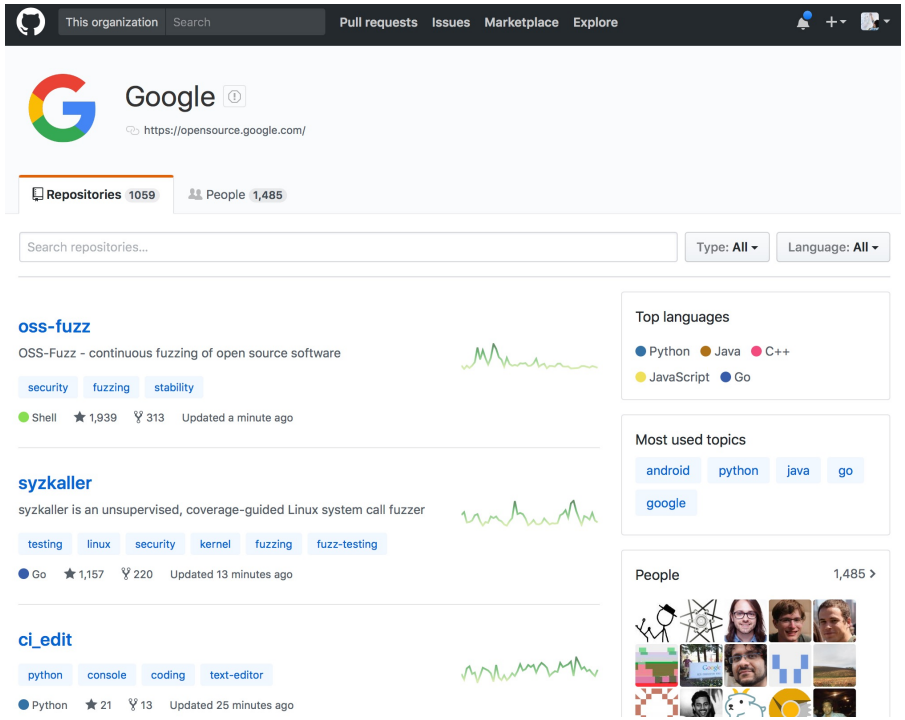
- Most popular software development platform: version control, easy-sharing scripts and data, etc.





GitHub

- Most popular software development platform: version control, easy-sharing scripts and data, etc.
- Everyone uses GitHub for the development, including Google, Facebook, etc.



GitHub

- Most popular software development platform: version control, easy-sharing scripts and data, etc.
- Everyone uses GitHub for the development, including Google, Facebook, etc.
- More and more people are creating and sharing a GitHub repository for their research and publications:

GitHub

- Most popular software development platform: version
- Everyone uses GitHub for the development, including C
- More and more people are creating and sharing a GitHu
  - E.g., Woo & Wager, 2016, PAIN

PAIN

What reliability can and cannot tell us about pain report and pain neuroimaging

Choong-Wan Woo[a,b], Tor D. Wager[a,b]

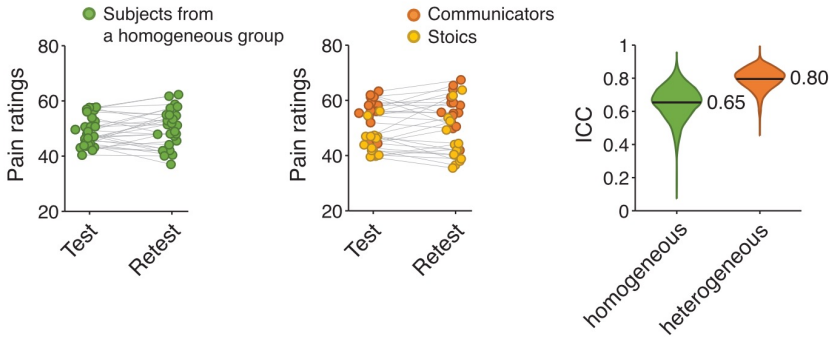
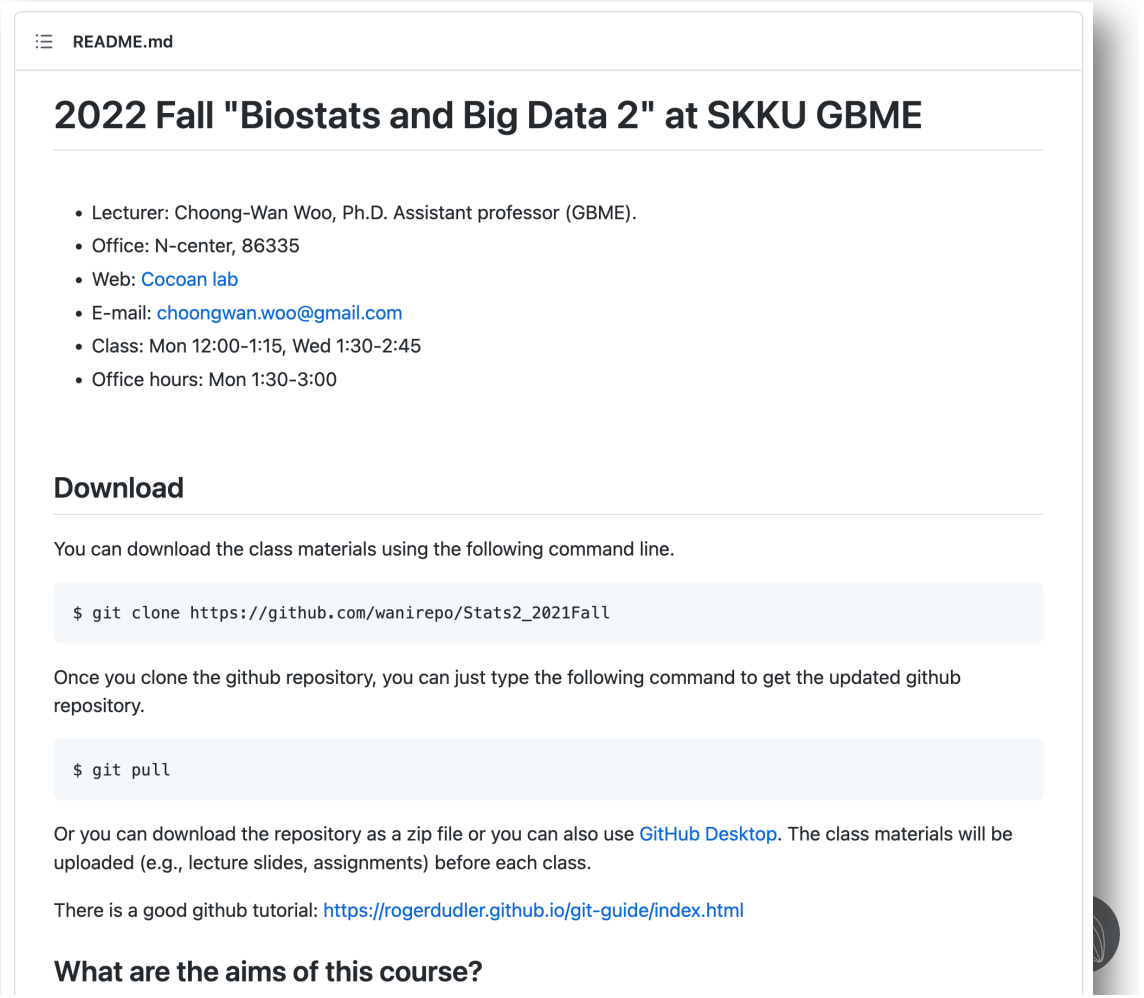


Figure 1. An illustration of the effects of sample heterogeneity on test–retest reliability of pain ratings. Reliability is generally a desirable property for any measure. However, any stable individual difference can increase reliability independent of the validity and utility of the measure in other respects. To illustrate this, we simulated intraclass correlation coefficients (ICCs), a measure of reliability, in samples (n = 30) consisting of one homogeneous population (green) or a mix of communicators that report higher pain and stoics that report less pain (orange and yellow, respectively). In the simulation, the mean pain ratings were set to 50, 55, and 45 for the homogeneous, communicator, and stoic groups. The between-person and within-person (across test/retest) SDs were set to 5 for all groups; thus, the noise levels were the same for both samples. We repeated the simulation 1000 times and observed the effects on the distribution of test–retest ICC values (right). The results show that more heterogeneous samples showed higher reliability (mean ICC = 0.80) than more homogeneous samples (mean ICC = 0.65). The principle of stable heterogeneity increasing reliability applies to both individual differences of interest (eg, genetic differences in pain sensitivity) and nuisance variables (eg, the use of multiple experimenters or variable testing procedures), as long as their effects carry over or are otherwise stable from test to retest. The simulation code is available at https://github.com/wanirepo/Woo_TRR_commentary_PAIN.

Our class website: https://github.com/wanirepo/Stats2_2022Fall

- README.md is the syllabus.
- Let's visit the website and read the syllabus together.



README.md

2022 Fall "Biostats and Big Data 2" at SKKU GBME

- Lecturer: Choong-Wan Woo, Ph.D. Assistant professor (GBME).
- Office: N-center, 86335
- Web: Cocoan lab
- E-mail: choongwan.woo@gmail.com
- Class: Mon 12:00-1:15, Wed 1:30-2:45
- Office hours: Mon 1:30-3:00

Download

You can download the class materials using the following command line.

```
$ git clone https://github.com/wanirepo/Stats2_2021Fall
```

Once you clone the github repository, you can just type the following command to get the updated github repository.

```
$ git pull
```

Or you can download the repository as a zip file or you can also use GitHub Desktop. The class materials will be uploaded (e.g., lecture slides, assignments) before each class.

There is a good github tutorial: https://rogerdudler.github.io/git-guide/index.html

What are the aims of this course?

Lastly,

Jamovi cloud vs. Jamovi local

To-do

- Sign up for slack

https://join.slack.com/t/wanistats2fall2022/shared_invite/zt-1f1m6tbx3-2~wp6NZRhd780GU09vD6fg

- Watch the “Softwares and programming languages” video