

Lecture 01

Class overview

Introduction

Lab webpage

<https://cocoanlab.github.io/>

COCOAN lab

Computational Cognitive Affective Neuroscience Laboratory



Cocoan lab is a neuroimaging research lab led by Dr. Choong-Wan Woo.

We are joining the [IBS Center for Neuroscience Imaging Research \(CNIR\)](#) at [Sungkyunkwan University \(Wikipedia\)](#) located in Suwon, South Korea (starting March 2017).

The **keywords** of our research include:

fMRI; Machine learning; Neuroimaging biomarkers; Data science; Translational research; Predictive modeling; Brain decoding; Encoding-decoding model; Pain; Emotions; Psychiatric and neurologic disorders; Mind-body interaction; Behavioral medicine; Network science; Psychological and social pain modulation; Emotion regulation, and more.

The mission of our lab is to understand **pain** and **emotions** in the perspective of data science, cognitive/affective/social neuroscience, and psychology. We also aim to develop clinically useful neuroimaging models and tools that can be used and shared across different research groups and clinical settings.

Our main research tools include functional Magnetic Resonance Imaging (fMRI; we're using 3T and 7T MRI), psychophysiology measures (skin conductance, pupillometry, electrocardiogram, respiration), electroencephalogram (EEG), and other behavioral measures such as facial expression, eye movement, etc. Most importantly, we use data science (computational) tools to model and understand affective, cognitive, and behavioral responses.



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. Buhle³, 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

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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 DA27794 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.

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Abbreviations: aINS, anterior insula; dACC, dorsal anterior cingulate cortex; dlPNS, dorsal-anterior 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,*}

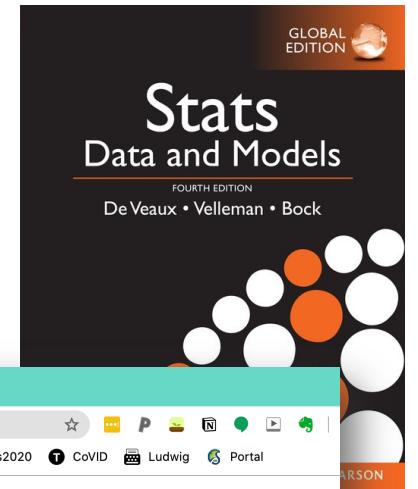
Abstract
 Cognitive self-regulation can shape pain experience, but its effects on autonomic responses to painful events are unclear. In this study, participants ($N = 41$) deployed a cognitive strategy based on reappraisal and imagination to regulate pain up or down on different trials while skin conductance 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-

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



Screenshot of a web browser showing the homepage of statsthinking21.org. The page title is "Statistical Thinking for the 21st Century".

statsthinking21
Main web site for Statistical Thinking for the 21st Century
[View the Project on GitHub](#)

Statistical Thinking for the 21st Century
An open source textbook for statistics, with companions for R and Python

Russell Poldrack
Stanford University

Core statistical text

- [Github repo](#)

R companion

- [Github repo](#)

Python companion (coming soon!)

- [Github repo](#)



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

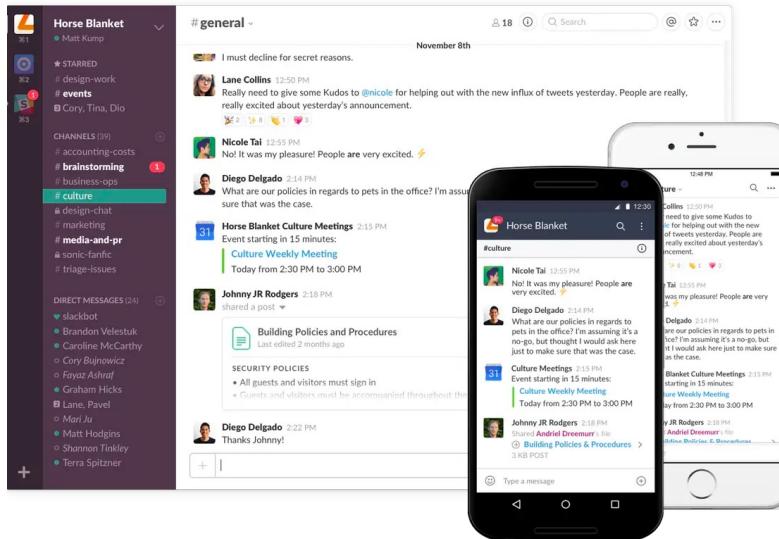


- A great platform for team communications

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

The screenshots illustrate a real-world usage of Slack. The desktop view shows a channel with messages about Kudos and a weekly meeting. The mobile view shows a similar channel with messages about policies and meetings. The detailed view of the '#advanced-fmri-analysis' channel shows a user (@Andrew You) posting a message with a link to a zip file, which likely contains a presentation or tutorial related to fMRI analysis.

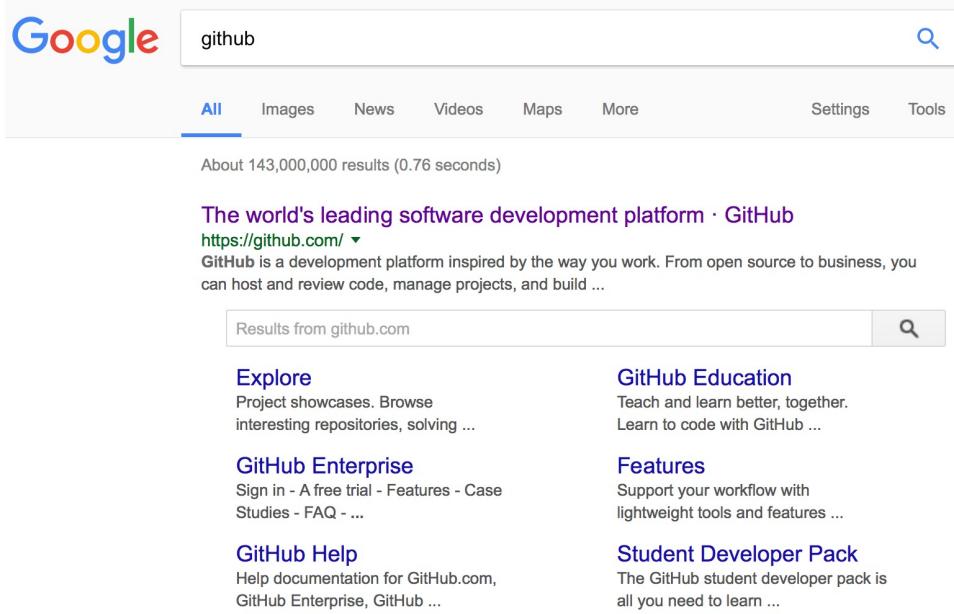


A screenshot of the Slack sidebar for the channel "wanistats2_fall2022". The sidebar includes a search bar, a "Browse Slack" button, a "Channels" section with "# class", "# general", and "# random", an "Add channels" button, a "Direct messages" section, and a "Wani you" button at the bottom.

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



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



Google search results for "github":

About 143,000,000 results (0.76 seconds)

The world's leading software development platform · GitHub
<https://github.com/> ▾

GitHub is a development platform inspired by the way you work. From open source to business, you can host and review code, manage projects, and build ...

Results from github.com

Explore
 Project showcases. Browse interesting repositories, solving ...

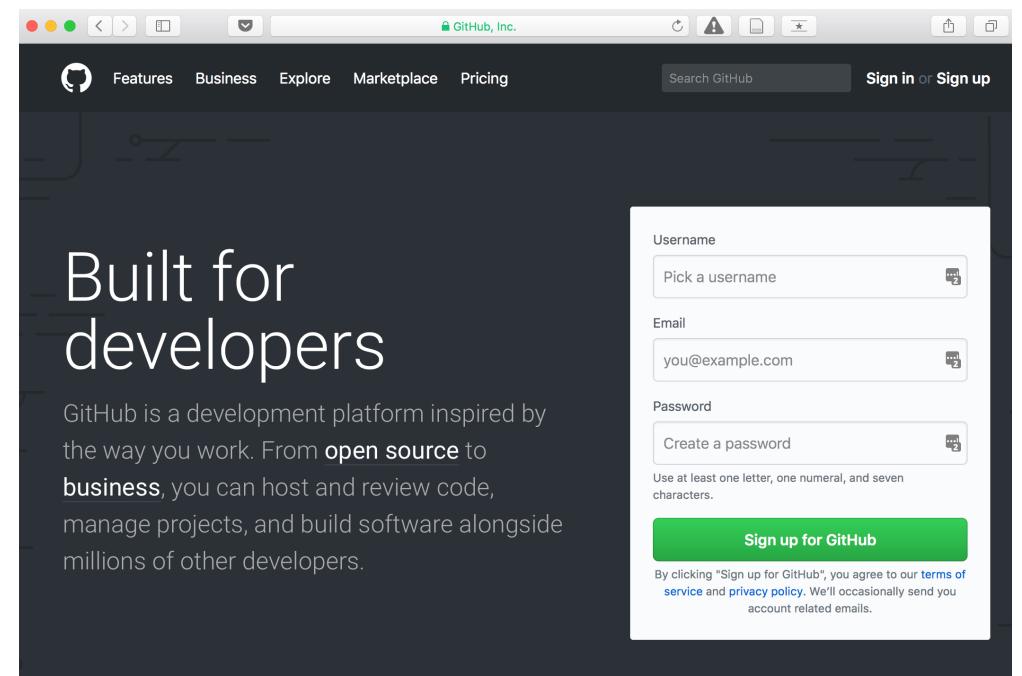
GitHub Enterprise
 Sign in - A free trial - Features - Case Studies - FAQ - ...

GitHub Help
 Help documentation for GitHub.com, GitHub Enterprise, GitHub ...

GitHub Education
 Teach and learn better, together. Learn to code with GitHub ...

Features
 Support your workflow with lightweight tools and features ...

Student Developer Pack
 The GitHub student developer pack is all you need to learn ...



Built for developers

GitHub is a development platform inspired by the way you work. From **open source** to **business**, you can host and review code, manage projects, and build software alongside millions of other developers.

Sign up for GitHub

By clicking "Sign up for GitHub", you agree to our [terms of service](#) and [privacy policy](#). We'll occasionally send you account related emails.



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

Google <https://opensource.google.com/>

Repositories 1059 People 1,485

oss-fuzz
OSS-Fuzz - continuous fuzzing of open source software
security fuzzing stability
Shell ★ 1,939 313 Updated a minute ago

syzkaller
syzkaller is an unsupervised, coverage-guided Linux system call fuzzer
testing linux security kernel fuzzing fuzz-testing
Go ★ 1,157 220 Updated 13 minutes ago

ci_edit
python console coding text-editor
Python ★ 21 13 Updated 25 minutes ago

Facebook <https://code.facebook.com/projects/>

Repositories 179 People 170

buck
A fast build system that encourages the creation of small, reusable modules over a variety of platforms and languages.
android python java ios buck build-tool
Java ★ 5,025 776 Updated 22 minutes ago

PathPicker
PathPicker accepts a wide range of input -- output from git commands, grep results, searches -- pretty much anything. After parsing the input, PathPicker presents you with a nice UI to select which files you're interested in. After that you can open them in your favorite editor or execute arbitrary commands.
Python ★ 3,469 215 Updated an hour ago

chisel
Chisel is a collection of LLDB commands to assist debugging iOS apps.
Python ★ 6,159 529 Updated 3 hours ago



- 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:



- Most popular software development platform: version control
- Everyone uses GitHub for the development, including C++
- More and more people are creating and sharing a GitHub repository
 - 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}

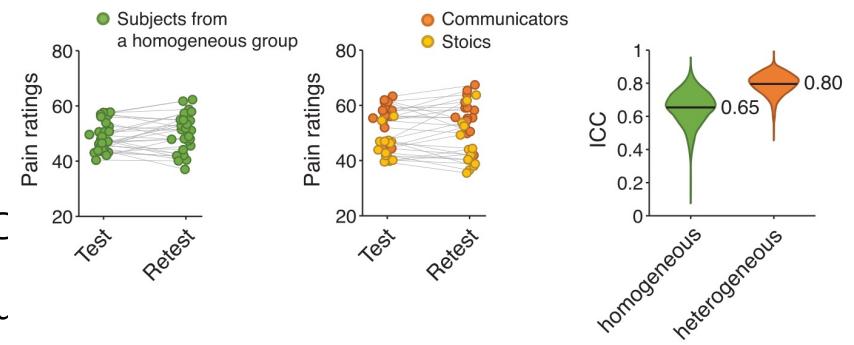


Figure 1. An illustration of the effects of sample heterogeneity on test-retest reliability of pain ratings. Reliability is generally a desirable property for any measure. However, any stable individual difference can increase reliability independent of the validity and utility of the measure in other 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