The Science of Experiments

Understanding human emotions, beliefs, and behaviors from data

1 - Introduction

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Introduction

- Who am I?

- How can you contact me?
  - email: christian.wallraven+SOEF2018@gmail.com
  - I do not have fixed office hours – please contact me via email anytime

Introduction

CognitiveSystems

- This course has a TA
  - 박여은
  - email: silver92_5@naver.com

- Both she **and I** will be happy to answer questions you may have

Introduction

- In this course, we will be looking at the science of experiments

- Can you name a famous science experiment?

World of Warcraft

- A 2013 study found that your personality predicts whether you play for gain or for socializing…

Graham and Gosling, Cyberpsychology Beh Soc Netw, 2013

Introduction

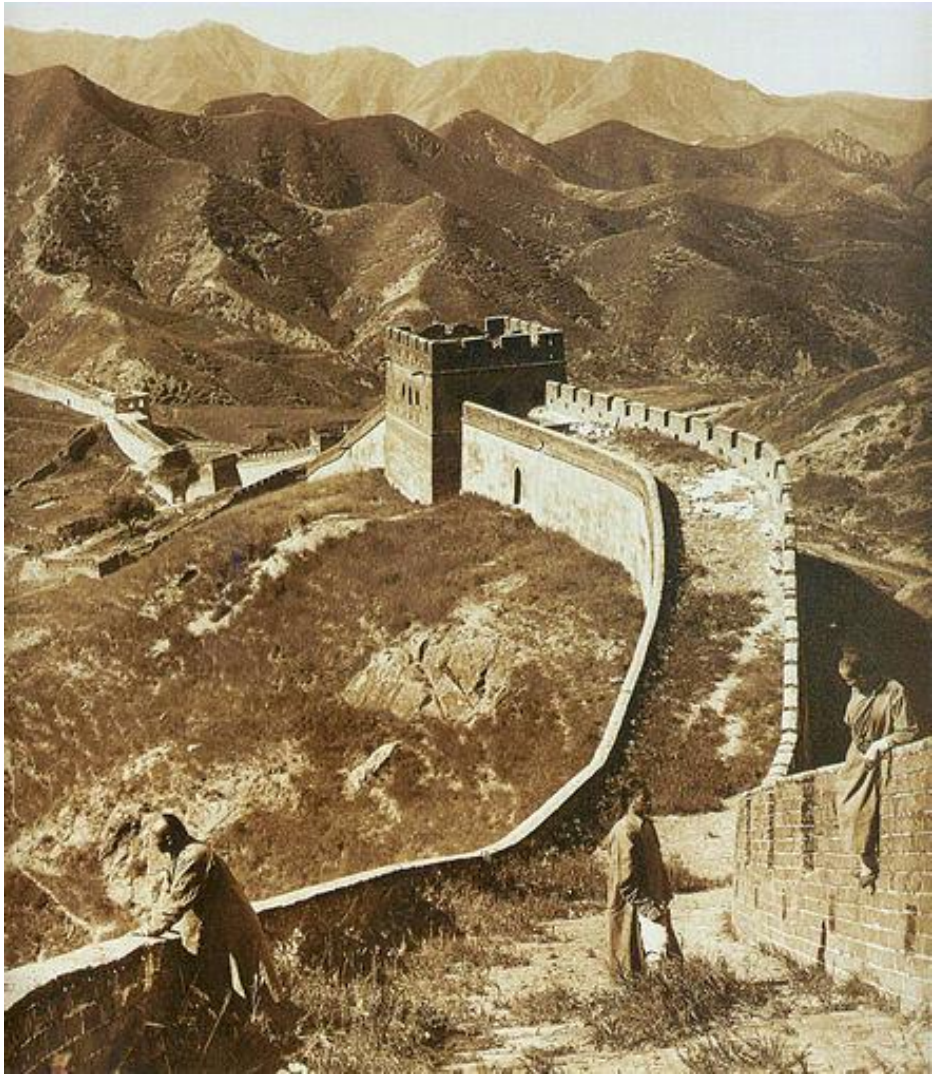
- In this course, we will be looking at the science of experiments
  - Specifically, those kinds of experiments that investigate the human condition (emotions, beliefs, behaviors)

Introduction - quotes

- “No amount of experimentation can ever prove me right; a single experiment can prove me wrong.” (Albert Einstein)
- “We are all agreed that your theory is crazy. The question that divides us is whether it is crazy enough to have a chance of being correct.” (Nils Bohr)
- “There's a lot of randomness in the decisions that people make.” (Daniel Kahneman)

An example

- Question:
- Is the Great Wall of China visible from space?



wikipedia

An “experiment”

- Please go to blackboard and vote!

The Great Wall of China

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Problems when asking questions

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- You have to define all terms properly!
- For the current problem ("Is the Great Wall of China visible from space?") you need to define "space" in terms of distance to the surface of the earth
- Why is this important for this class?
- Doing experiments means essentially
  - asking a question
  - collecting data to answer it
- If your question is ill-posed the results will do little to answer the question you had in mind!

Keypoint

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Better way to phrase question

- Is the Great Wall of China visible from ISS orbit?
- Here's a tweet from astronaut Chris Hadfield from 2013

NASA, BBC

Other things visible from “space”

- Other human-made structures visible from ISS orbit:
  - Bingham Canyon copper mine in Utah
  - 4 km wide!

wikipedia

Other things visible from “space”

- Other human-made structures visible from ISS orbit:
  - Palace of Parliament in Bucharest, Romania
  - Built in the 1980s with 1100 rooms

wikipedia

선풍기 사망설

- Question:
- Is it dangerous for your health to leave a fan running in a closed room?

An “experiment”

- Please go to blackboard and vote!

선풍기 사망설

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선풍기 사망설

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선풍기 사망설

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- This is another common fallacy in science
- Believing something is true, just because everybody says it!
- The story usually runs deeper!

Keypoint

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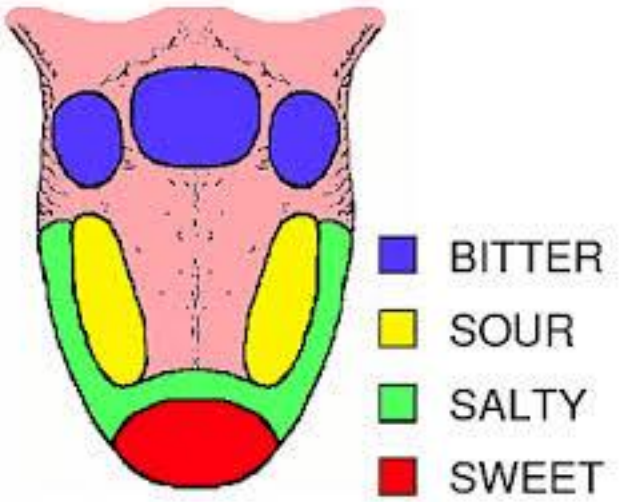
More problems

- Perhaps you have famously heard of the “tongue map”
- Different parts of the tongue are said to taste different types of taste, such as shown here
- But: this is not true!
- Fact is that all parts of the tongue can taste all tastes, but with some differences in distribution



wikipedia

More problems

- The reason for this is due to a mis-translation of a German thesis in which these differences are discussed in different terms
- In addition, as you probably know there is at least one more basic taste
  - Umami = Glutamate
  - there is recent discussion to include “fat” as another taste!!

popsugar, cooking-memories

Keypoint

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The Monster study

- In 1939, 22 orphans were divided into two groups under the supervision of W. Johnson
- One group was told that their speech pattern was horrible and non-fluent, the other was praised for their speech
- Subsequently, many children in the first group developed speech impediments, some retaining these for the rest of their lives

Tudor, 1939

The Monster study

- The results of the experiment were never published for fear of ethical repercussions
  - see experiments by Nazis at the same time!
- Largest “controlled” study on the onset of stuttering – in fact, this study **proves** the power of higher-level factors in the development and maintenance of stuttering behavior!

Keypoint

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The Ultimatum Game

- Let’s play another game. I give you 10000 Won. You have to divide the money between you and your neighbor. If your neighbor rejects the offer, NO-ONE receives money.
- How much would you offer??

An “experiment”

- Please go to blackboard and enter your amount!

The Ultimatum Game

CognitiveSystems

- Most people will split the amount, offering 50/50
- Rationally, however, the other person should accept ANY amount, since gaining even little is better than before!
- Usually, however, people reject offers less than 30%
- This illustrates the influence of “fairness”, “reputation”, and social norms in the modeling of human economic decisions

Keypoint

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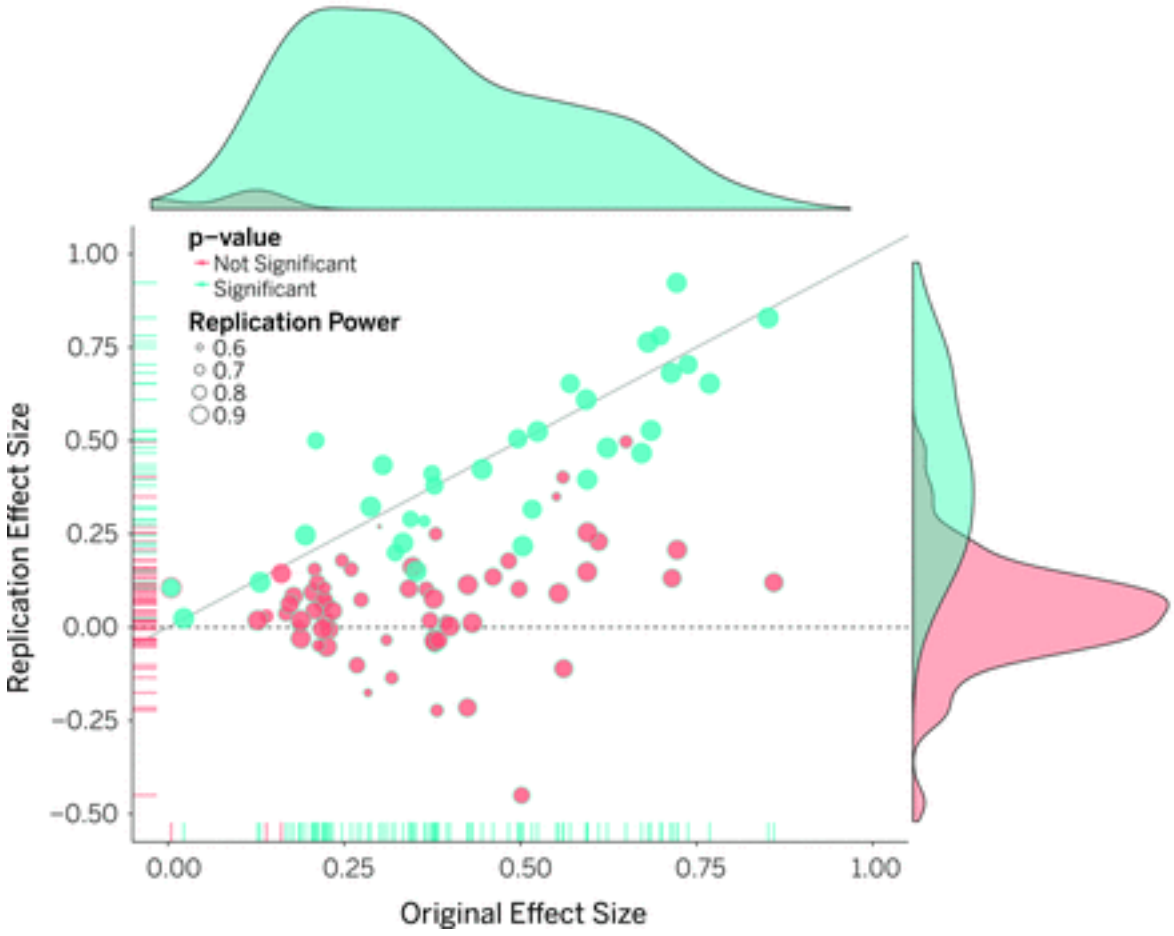
Reproducing science

- One of the core elements of science is the idea of reproducibility
  - results should be the same if the experiment is repeated!
- However, reproducing studies usually does not gain the scientist anything – you cannot publish the same results again!
  - therefore, reproducing studies is rarely done – especially in Psychology
- Recently, a group of scientists has selected 100 studies from leading Psychology journals and tried to replicate them – with the original data if possible

Reproducing science

- Of the 100 studies, only 40 were rated to reproduce the original result
- We will discuss this in more detail during the course



Open Science Collaboration, science, 2015

Keypoint

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Course structure

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- We will start with the philosophy of experiments
  - What is an experiment?
  - How do we make one?
  - What are examples of famous experiments in science?
- Next, we will look at how to model and analyze experiments
  - How do we describe experiments mathematically?
  - How do we do simple statistics to infer whether we found something?

Course structure

- The main part of the course will be devoted to an in-depth review of (in)famous experiments in psychology and neuroscience
  - Topics range from lower-level brain processes to high-level beliefs and even human social interaction
- For each topic, I will review and discuss a few landmark studies with respect to
  - scientific background and main question
  - theoretical, practical and ethical implications

Course goals

- To get an understanding of core concepts in experimental design
- To connect design and analysis and to learn the basics of experimental analysis
- To get an overview of classic experiments about all aspects of human existence
- **To stimulate critical reading and creative thinking**

Course content

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- Part 1 – the science of experimentation (~10 lectures)
- Introduction to Experimental Design (~4 lectures)
  - Philosophy of experiments – what is an experiment and how can we model this mathematically?
  - How to get information from people – designing psychological and neuroscience experiments

Course content

CognitiveSystems

- Part 1 – the science of experimentation (~10 lectures)
- Experimental Analysis – Statistics made easy (~5 lectures)
  - Basic introduction to statistics
  - Describing patterns in data – a *gentle* intro to exploratory data analysis
  - Making conclusions about data – a *gentle* intro to inferential data analysis
- Multiple-choice exam about basic concepts in experimental design and analysis

Course content

- Part 1 – the science of experimentation (~10 lectures)
- Multiple-choice exam about basic concepts in experimental design and analysis
- FAQ:
  - yes, this comes early on in the course
  - yes, this will be the “mid-term” exam of this class
  - I will provide some example questions in the previous lectures – so listen carefully ☺

Course content

- Part 2 – understanding humans (~20 lectures)
- Perception (~4 lectures)
  - Introduction lecture – how the world gets into our brain
  - From short to long – the limits of memory
  - Attention to detail and dress colors – failures of perception

Course content

CognitiveSystems

- Part 2 – understanding humans (~20 lectures)
- Learning and conditioning (~4 lectures)
  - Introduction lecture – how the brain learns
  - Conditioning – imprinting emotions and behaviors
  - Animals or humans? – complexity of behavior

Course content

- Part 2 – understanding humans (~20 lectures)
- Emotions and Culture (~4 lectures)
  - Introduction lecture – how emotions color our world
  - There is something in the face – or not? Emotions around the world
  - Being WEIRD at 7 – science finally is studying everyone

Course content

- Part 2 – understanding humans (~20 lectures)
- Personal beliefs (~4 lectures)
  - Introduction lecture – the complexity of who I am
  - Forming opinions and keeping them – problems of choice and morality
  - Refusing to obey and being imprisoned – pushing the boundaries of human existence

Course content

- Part 2 – understanding humans (~20 lectures)
- Exam dealing with critical reading of one experiment and answering of multiple-choice questions to this as well as other experiments discussed in class
- FAQ:
  - the exact date of the final exam depends on how fast we proceed through the syllabus
  - I will provide you with an example exam before
  - if you attended the lectures and followed the discussion, you should have absolutely **no problem**

Course reading

- Part 1 will follow the logic of
  - Cunningham, D. W., & Wallraven, C. (2011). Experimental design: From user studies to psychophysics. CRC Press.
- Part 2 – understanding humans (~20 lectures) will report some experiments that can be found in
  - Hock, R. R. (2012). Forty studies that changed psychology. Prentice Hall

Course reading

- In addition, part 2 will discuss research papers – some of them classic, old ones and some of them brand-new.
- The papers are listed in the syllabus and can readily be accessed from within KU by googling their title
- **If you need a PDF of any paper, please do come and see me!**

Course reading

- Additional reading:
- Any good textbook on neuroscience, such as:
  - "Principles of Cognitive Neuroscience" Dale Purves et al., Sinauer, 2008 (1st edition) or 2013 (2nd edition).
  - "Sensation and Perception" Bruce Goldstein, Cengage Learning, 2009 (8th edition) or 2013 (9th edition). Older editions are also fine. Korean edition available.
- Book on how the mind works (and does not):
  - "Thinking, fast and slow" Daniel Kahneman, Farrar, Straus, and Giroux, 2013. **One of the best books you can read in general!!!**

Course policies

- Grading will be determined solely by the exams, but you can get a 10% bonus from attendance!
- I will check attendance randomly 4 times during the semester, and each time you are present, you receive a 2.5% bonus on your grade
- Final grade =
  0.4*first exam + 0.6*second exam + 0.1*attendance

Q&A

- Any questions as far as organization is concerned?

STAND BACK!

WE'RE DOING SCIENCE!